

The AMSAT[®] Journal



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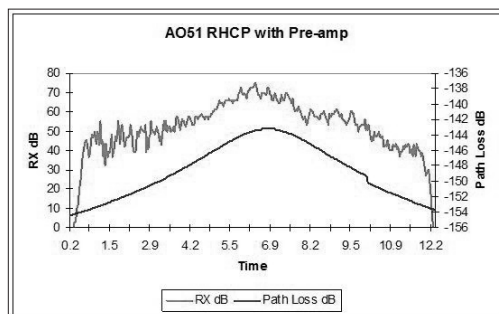
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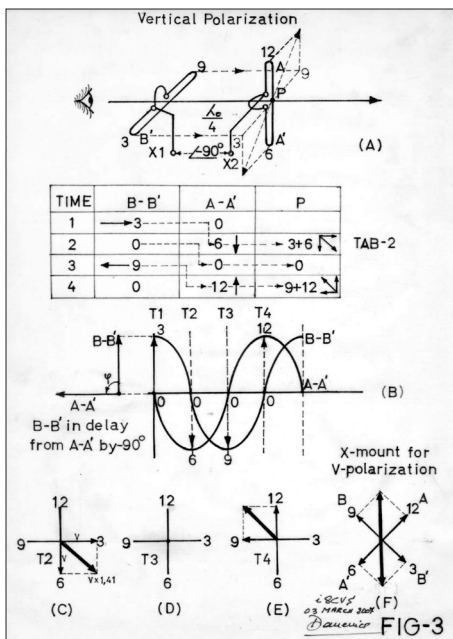
March/April 2007



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AMSAT Announcements

**NOTICE: AMSAT-NA Board of Directors
Nominations Due No Later Than June 12, 2007**

It is time to submit nominations for the upcoming open seats on the AMSAT-NA Board of Directors. A nomination requires either one Member Society or five current individual members to nominate an AMSAT member for the position. A director serves for a period of two years. Four directors' terms expire this year: Barry Baines, WD4ASW, Emily Clarke, N1DID, Rick Hambly, W2GPS, Gunther Meisse, W8GSM. Nominations **MUST** be in writing and mailed to:

AMSAT
850 Sligo Ave #600
Silver Spring, MD 20910

See the announcement on page 17 concerning the AMSAT/TAPR Banquet at the Dayton Hamvention this year. The banquet will be held at the Air Force Museum. This is a fascinating place and if you haven't been there, this is a great opportunity to tour the museum and have a great dinner in the company of AMSAT and TAPR members.

AMSAT Field Day - See Page 22.

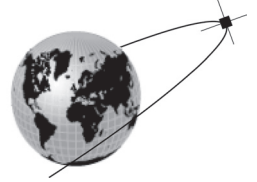
AMSAT's Mission

AMSAT is a non-profit volunteer organization which designs, builds and operates experimental satellites and promotes space education. We work in partnership with government, industry, educational institutions and fellow Amateur Radio societies. We encourage technical and scientific innovation, and promote the training and development of skilled satellite and ground system designers and operators.

AMSAT's Vision

Our Vision is to deploy high earth orbit satellite systems that offer daily coverage by 2009 and continuous coverage by 2012. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups.





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The AMSAT Journal staff is always interested in article submissions. Whenever possible, submissions should be sent via e-mail to journal@amsat.org using plain text or word processor files; photos or figures in TIF, GIF or JPEG formats. AMSAT-NA reserves the right to select material for *The AMSAT Journal* based on suitability of content and space considerations. The editors of this publication are volunteers giving freely of their talents, time and efforts to produce *The AMSAT Journal*.

SPRING IS HERE AMSAT-DC Meeting Kicks Off the Season

The 2007 AMSAT-DC Meeting and Space Symposium was held on March 24. It represented the first of many meetings that will be held over the spring and summer months that are of interest to AMSAT. Our thanks go to Pat Kilroy, N8PK, for hosting the meeting, to Gary Chatters, WA9ZZZ, for running the talk-in station and to Charlie Heisler, K3VDB, and Tom Clark, K3IO, for serving as our photographers. We also thank Sean Barnes, N3JQ, physics teacher at Trinity High School, for video taping the meeting.

The presenters were Scott Stevens, N3ASA, Rick Hambly, W2GPS, Dan Schultz, N8FGV, Bob Davis, KF4KSS, HaoQi "Esther" Li, K14LJD, Charlie Heisler, K3VDB, Bob Bruninga, WB4APR, Heru Walmsley, W3WVV, and Tom Clark, K3IO.

It is great to see the many AMSAT people committed to this modest local meeting every year. Through the dedication of many local hams, especially Pat Kilroy, N8PK, this has been a very high quality and successful meeting over the years. I encourage interested AMSAT members in other areas to set up similar meetings. I would be pleased to attend your meetings if my schedule permits.

Dayton is the Highlight of the Spring Season

The 2007 Dayton Hamvention will be held this year on May 18 - 20, 2007. It is the premier spring event for AMSAT and, judging from the early room and banquet reservations, we expect a very strong showing from AMSAT members. Check out the AMSAT Web site for the latest information on AMSAT events. The AMSAT forum will be on Friday from 11:15am to 2:00pm in Forum Room 1, which is a change from prior years. The first joint AMSAT/TAPR Banquet will be held Friday evening at the Air Force Museum. The "Dinner Under the Wings" event will begin at 6:00 pm. It promises to be a very exciting year for AMSAT at Dayton. I hope to see you all there.

Software Defined Transponders Odyssey, the SuitSat-2 Transponder, Takes Shape

Since the exciting, but technically disappointing, SuitSat-1 mission in February 2006, AMSAT has been preparing for a possible follow-up mission, dubbed SuitSat-

2. While the mission is not yet approved, we have moved forward on the design of a new set of hardware that will provide a multi-mode transponder, a camera and other features.

The transponder is being designed in cooperation with the High Performance Software Defined Radio group (www.HPSDR.org) and has been code named Odyssey. It is a low power transponder capable of being configured in linear (SSB/CW), FM and data modes.

On March 12th this transponder came to life with tests in FM, AM and SSB modes by K3IO, N4HY and W2GPS. This milestone was due to the hard work of the Odyssey development team Joe Julicher, N9WXU, Steve Bible, N7HPR, Frank Brickle, AB2KT, Bob McGwier, N4HY, and Lou McFadin, W5DID. Thank you all for volunteering your time and energy to enhance the future of AMSAT and ham radio.

Phase 3E Satellite

Howard Long, G6LVB, has been working on the Mode B (U/V) transponder that is based on his software defined transponder (SDX) with Stella signal equalizer that he demonstrated at last year's AMSAT-UK Colloquium. Howard is also replicating the AO-13 UHF receiver as an RF front end to the SDX.

The CAN-Do! Satellite Bus modules and the Internal Housekeeping Unit (IHU-3) have been developed in North America and are now on the critical path for P3E integration. Unfortunately, a series of technical and schedule problems have delayed delivery of these items to Germany and I sincerely apologize to the German team leaders for this delay. We are working on resolving these problems quickly.

The most frequent question I am asked about P3E is when will it launch? There is little I can say right now as negotiations are underway and I do not want to interfere with that process. What I can say is that I will have my station ready for P3E by the end of 2008.

Eagle Satellite

The Eagle satellite is progressing on many fronts. The software defined transponder

Apogee View continues on page 16 ...



Signal Fading Study Technique

by Mark Spencer, WA8SME, mspencer@arrl.org

ARRL Education and Technology Program Coordinator

Satellite signal fading is an operating reality that each satellite user deals with. Through observation and listening to others on the birds, some interesting and conflicting effects of fading become evident. Some operators would comment on deep fades while I did not experience any fading at all. At other times, I experienced a deep fade while other operators carried on as if nothing had happened. Additionally, some satellites seemed to be more prone to fading than others.

I thought it would be interesting to try to quantify signal fading to see if I could get my arms around what is happening and perhaps come to some conclusion as how to mitigate the effects of signal fading by improving my station. In particular, I wanted to see if polarity switching of my RHCP antenna would be worth the cost, effort, and complexity.

And, as always, I also wanted to explore a technique that teachers might be able use with their students to advance the student's work with satellites and perhaps do a little research of their own. The three sidebars are specific "Benchmarks" [1], or learning objectives, that should be taught to high school students as part of the curriculum that leads them to gain "Science Literacy." The activity described here is one way that teachers can combine the use of ham radio satellites with the learning objectives required in the student's mathematics and science curriculum.

Background

One of the most understandable discussions I have come across on the efficiency of signal reception related to antenna design and

performance and RF propagation issues are contained in a paper published by Cushcraft Corporation [2]. I highly recommend this reading as a good starting point for those interested in signal fading.

In this signal fading study technique, you need to have a constant carrier from the satellite. The prime candidates of course are AO51 and AO27. I would have loved to be able to look into SO50, because this bird seems to experience the deepest fades, but the bird is carrier activated and I have yet to figure out a way to work with an intermittent carrier. Also, to study signal fading, you need a way to sample and measure the signal strength from the bird during the pass.

Station Setup

The station setup that I used for this activity consisted of an Icom IC-910, antenna mounted pre-amp, an M² 436CP30 30-element RHCP Yagi antenna, a 7-element Arrow Yagi antenna mounted for horizontal polarization and a full AZ/EL rotor system. I also use a homebrew USB/CI-V interface to control the IC-910 with a computer [3]. By sending a command to the IC-910 through the CI-V port, the radio will report back to the computer the S-meter level with a number between 0 and 255 (the ADC value of the signal level).

I developed a simple computer program (Signal Fade Study Program) that sends the query to read the S-meter of the IC-910, converts the returned S-meter reading to decibels and dumps the data with a time stamp to an Excel spreadsheet. Figure 1 is a screen shot of the operating software. The program is written in Visual Basic 6.0. (The source code and program are available for the cost of an e-mail request to the author at mspencer@arrl.org. This program is specifically for the IC-910 and has only been run and tested on a Windows XP machine.)

Methodology

I collected data from a number of AO51 and AO27 passes using both the RHCP and horizontal Yagi antennas. As the satellite approached AOS, I launched the Study Program and tuned the IC-910 to the downlink frequency. When the satellite downlink was heard, I started collecting data and manually tracked the downlink frequency. At LOS, I stopped data collection and saved the Excel spreadsheet

for further analysis. To provide a reference for signal strength, I imported into the Excel spreadsheet the distance between the satellite and the station using the NOVA list utility. Then using an Excel math formula, the path loss was calculated and the result was added to the graph of collected signal strength for comparison. The formula for converting distance between the satellite and the station to path loss is:

$$dB_{PathLoss} = -20 \log \left(\frac{4\pi D_{meters}}{\lambda_{meters}} \right)$$

Figures 2 through 7 are representative graphs for data collected from AO51 and AO27 using the indicated antenna, either RHCP (with and without pre-amp) or horizontal Yagis.

Observations

Many of the antenna system performance challenges detailed in the Cushcraft paper are indicated in the graphs. The reader is encouraged to interpret the data and come to his/her own conclusions. A few of the observations that came from my interpretation of the data include:

1. The signal from AO51 appears more stable (reduced fading) than AO27. (Probably due to the RHCP antenna on AO51 on this downlink frequency and the linear antenna on AO27.)
2. The relative amount of fading was less for both AO51 and AO27 when using the RHCP antenna when compared to the fixed horizontal Yagi (taking into account the difference in gain).
3. The pre-amp helped to bring most of the deep fades up above the minimum signal level required for usable signals.
4. There are other interesting patterns, for instance, the periodicity of the AO27 signal fades (which are probably related to the rotation of the satellite).

For students, the real power of this activity is interpreting the graphs and speculating on what is going on. This speculation could lead to further investigation (the real reason behind the learning objectives).

Receive-Diversity Techniques

There are numerous techniques that can be employed to reduce the effect that signal fading has on a successful satellite QSO. A short list of these techniques includes improving antenna gain, adding pre-

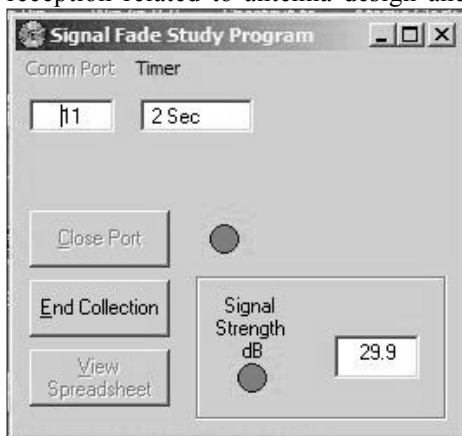


Figure 1: Calculation software.

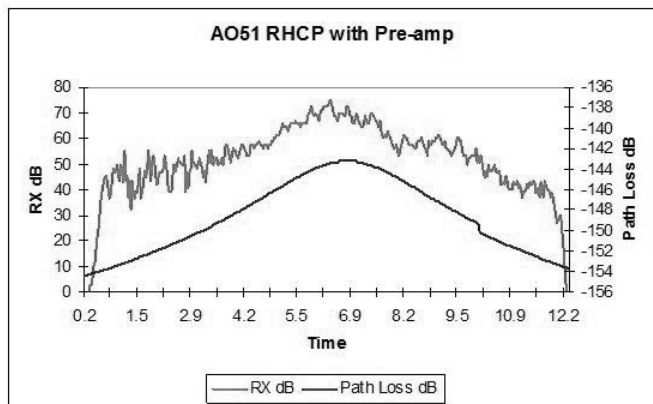


Figure 2

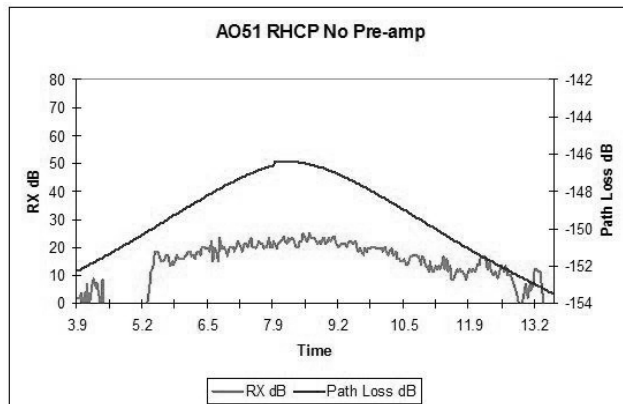


Figure 3

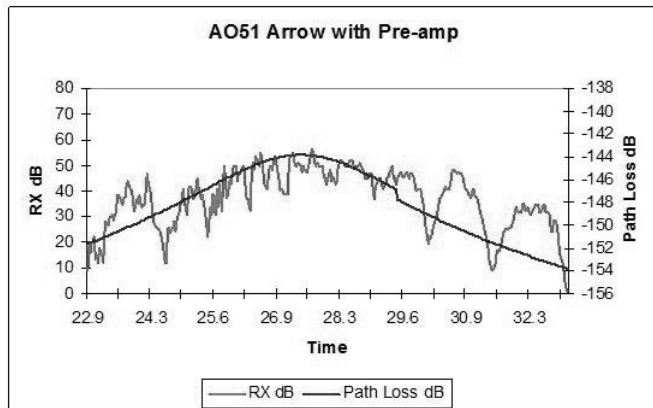


Figure 4

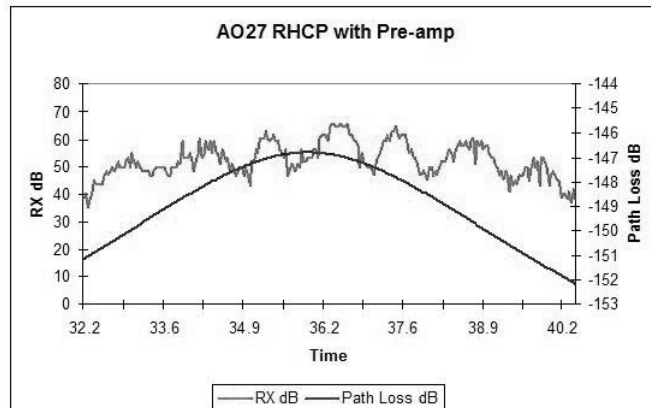


Figure 5

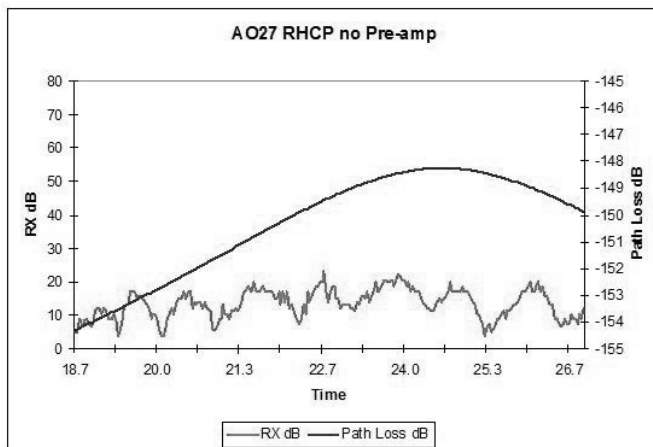


Figure 6

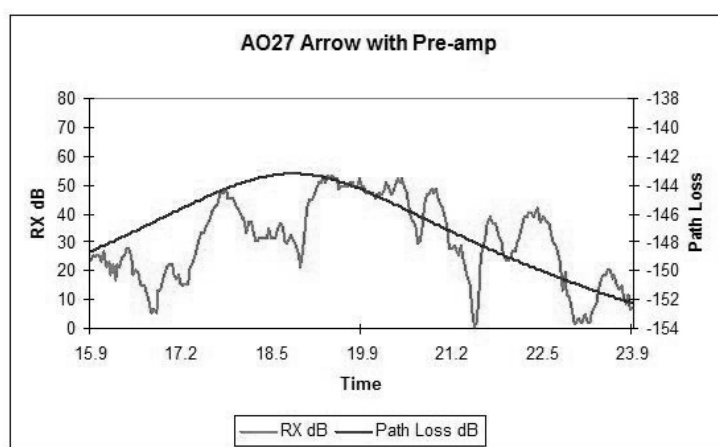


Figure 7

amplifiers, upgrading coax and connectors, adding circular polarization and adding polarization agility (switching). It really comes down to how much each technique costs and/or how much effort is required to implement the technique, i.e., getting the most bang for the buck.

The prioritized list of antenna system improvements (getting the most bang for the buck) that became clear to me as a result of this activity is:

1. Upgrading coax and connectors. Reducing signal loss in the antenna feed line system will improve overall

antenna system performance no matter what antenna changes are made.

2. Increase antenna gain and/or adding antenna-mounted pre-amps. Increasing antenna gain will bring the fade "minimums" up to a level that will perhaps be above the minimum usable signal level of the receiver.
3. Upgrade the antenna to appropriate circular polarization sense for the satellites of interest (either RHCP or LHCP). Circular polarization will provide some improvement in performance regardless of the shifting

polarity of the signal. (I tend now to think more along the lines of elliptical polarization versus circular polarization.)

4. Add polarization agility (RH/LH CP switching). This capability would provide the flexibility to work different satellites with different antenna polarization architectures and also provides some flexibility to react to real-time signal fading. To answer my own question, RH/LH CP switching would be nice to have but not worth the expense for my current interests.

The basic idea of mathematical modeling is to find a mathematical relationship that behaves in the same ways as the objects or processes under investigation. A mathematical model may give insight about how something really works or may fit observations very well without any intuitive meaning.

The usefulness of a model can be tested by comparing its predictions to actual observations in the real world. But a close match does not necessarily mean that the model is the only "true" model or the only one that would work.

Computers have greatly improved the power and use of mathematical models by performing computations that are very long, very complicated, or repetitive. Therefore computers can show the consequences of applying complex rules or of changing the rules. The graphic capabilities of computers make them useful in the design and testing of devices and structures and in the simulation of complicated processes.

More on Computer Modeling

The Signal Fading Study Program can also be used with other antenna modeling programs to address other education benchmarks. I used the ARRL EZNEC 3.0 program that comes with the *ARRL Antenna Handbook* [4] to model the Arrow antenna. This provides the computer-generated prediction of the antenna radiation pattern addressed in the benchmark. Then I used an HT (with some attenuation) as a signal source, the Study Program and IC-910 connected to the Arrow antenna and collected signal strength data as a function of azimuth angle to the signal source to create the actual antenna pattern (the second part of the benchmark). The results are displayed in the graphics of Figures 8 and 9. The measured antenna pattern compares remarkably well to the predicted radiation pattern modeled by the computer and attests to the utility of computer modeling of real world systems (the desired outcome of the benchmark).

Conclusion

You can explore many facets of ham radio satellites without sophisticated and expensive test equipment. By adapting your current radio equipment and exploiting all of the features, you can take a closer look at the science of radio under practical conditions. In this case, a simple computer program that uses off-the-shelf software (Excel) can provide some interesting insights as to what is happening between the satellite and your station, and can provide inexpensive learning opportunities for students that address learning objectives in a non-traditional, fun, and meaningful way.

References

- [1] *Benchmarks for Science Literacy*, American Association for the Advancement of Science, 1993, ISBN-0-19-508986-3.
- [2] *Antenna Polarization Considerations in Wireless Communications Systems*, Cushcraft Corporation, <http://www.cushcraft.com/comm/support/pdf/Antenna-Polarization-14B32.pdf>
- [3] May 2007 *QST Magazine*.
- [4] *The ARRL Antenna Handbook*, 20th Edition, 2003, ISBN-0-87259-904-3

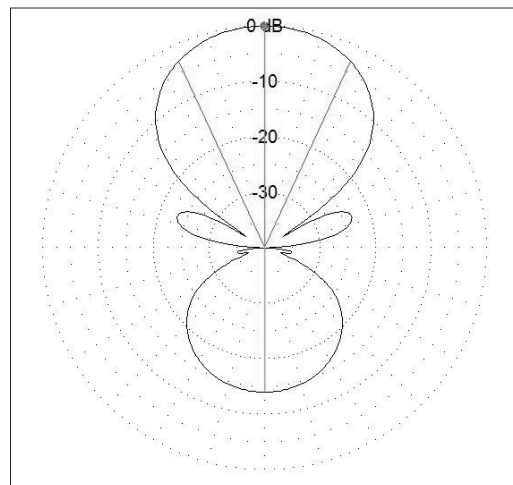


Figure 8

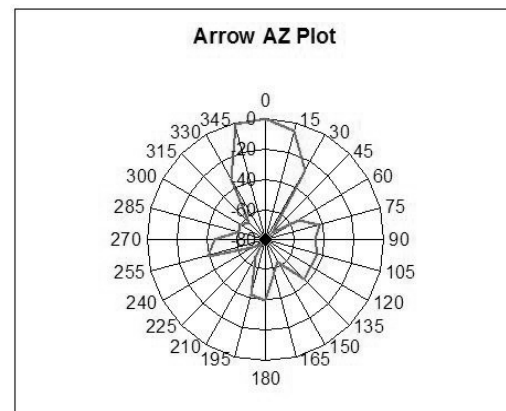


Figure 9



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Exciting new look!
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Switching Four Polarizations on a 70 cm Crossed Yagi (Part 1)

by Domenico Marini, I8CVS, domenico.i8cvs@tin.it

Introduction

Switching horizontal/vertical RHCP and LHCP polarizations on a 2 meter crossed Yagi has been described in [1] and [2] but very little has been written for 70 cm. Additionally, all commercially available satellite antennas are actually designed to switch only between RHCP and LHCP. The need to design a four polarization switcher started when the downlink of FO-29 at 435.850 MHz was masked at low satellite elevations by vertically polarized white noise generated and radiated by a powerful TV station located on the top of a hill 15 km away from my location.

The vertically polarized noise as received by my RHCP helix antenna in that direction was about 20 dB above the noise floor and the only way to cancel out the noise was to receive FO-29 from AOS and during the first critical part of the orbit using not circular, but the opposite linear polarization to the offending signal, i.e., horizontal polarization. So a new antenna with four switching modes from linear to circular was required.

By the way, a switchable capability from linear to circular polarization is not a waste of time because a 70 cm crossed Yagi can be used with maximum performance for satellite and tropo communications.

The switcher discussed above (Photo 4) was designed around four inexpensive and light weight commercially available 50 ohm TOHTSU model CX 120 P coax relays originally developed for printed circuits in 2 meter and 70 cm preamplifiers. The following results were obtained:

- 1) VSWR = 1.5:1 maximum on each polarization
- 2) Circularity RHCP and LHCP = 2 dB max

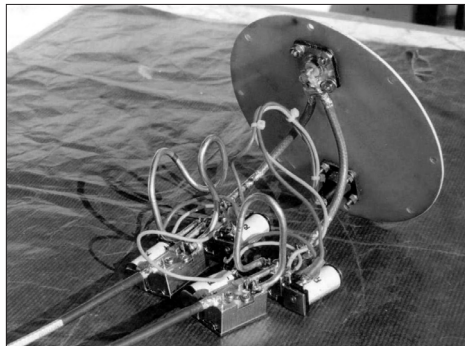


Photo 1

- 3) Cross-polarization RHCP to LHCP = 15 dB min
- 4) Axial ratio linear H to V = 17 dB min
- 5) Overall attenuation = 0.5 dB max
- 6) Power handling = 300 watt CW nominal
- 7) Weight = 800 grams and waterproof to IP-55

In this polarization switcher (Figure 1) the needed phase difference (ϕ) is determined only by the electrical length λ_e of the coaxial cables and it is not necessary to take the delay time of the relays into consideration, as long as they are identical in each branch, i.e., if both pairs of relays, even if built by a different manufacturers, have the same electrical length.

All input and output connections as well those between coax relays are made using Teflon insulated (PTFE) coax cables, which withstand high soldering temperatures to allow all braids and center conductors to be soldered directly to relay ports eliminating twelve unnecessary connectors thus greatly reducing cost and insertion loss (Photos 1 and 2).

In addition, PTFE has a constant and stable velocity factor ($V_f = 0.694$), which permits calculation and cutting of the length of the coax cables with great accuracy to get the needed electrical wavelength λ_e for each delay line.

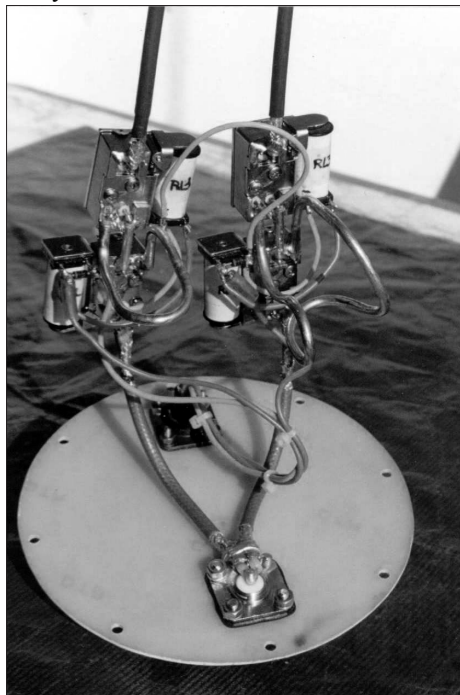


Photo 2

The use of a printed circuit boards is not recommended here because any microstrip effects from the PCB's will introduce differences in the length of the delay lines, which are impossible to evaluate and trim out without having access to a network vector analyzer.

Theory of Operation and Function

This switcher has been designed and built around an existing 70 cm antenna (the KLM 435-40CX), but any other type of crossed Yagi can be used provided the elements are physically spaced over the boom by $1/4\lambda_0$ (Figure 1).

The original KLM CS-2 circularity switcher was designed only for RHCP and LHCP and so it was removed, but the rest of the antenna was left in its original condition including both the $1/2 \lambda_0$ coax balun BN with 4:1 impedance ratio connected across the folded dipoles.

The schematic diagram in Figure 1 shows the new polarization switcher with relays RL1 and RL2 feeding the rear dipole via coax cable X1 and relays RL3 and RL4 feeding the front dipole via coax cable X2.

Note that the individual branches of this switcher are only loaded with half the output power distributed evenly to both relay pairs and to both dipoles in all polarization modes. Since the nominal power of each relay CX 120 P is 150 watts, the nominal power capability of this switcher becomes 300 watts.

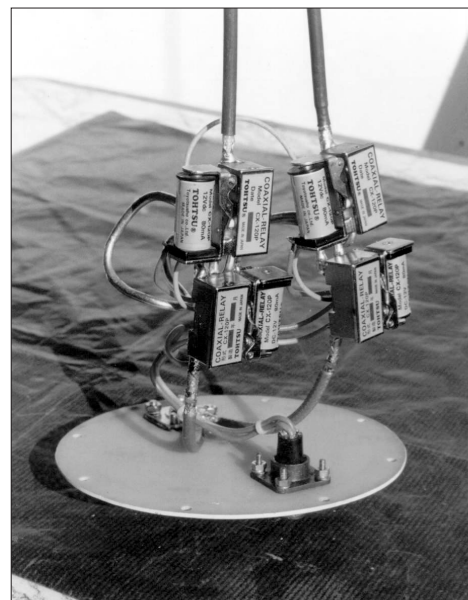


Photo 4

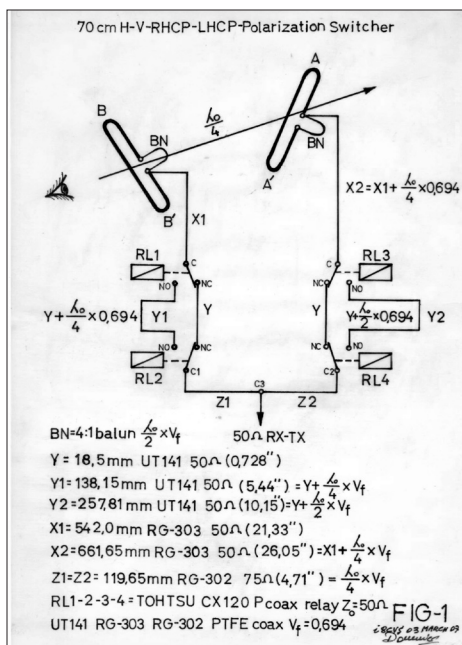


Figure 1: Switcher schematic.

Coax lines X1 and X2 are made with PTFE RG-303 coax, $Z_0 = 50 \text{ ohm}$ and velocity factor $V_f = 0.694$. X1 can be cut to any convenient length but X2 must be longer than X1 by $1/4 \lambda_e$ at 435.0 MHz, that is, 119.65 mm longer, because the electrical wavelength λ_e is calculated with $\lambda_0 \times V_f$, where λ_0 is the free space wavelength. Since in this prototype X1 has been made 542.0 mm for reference, then X2 becomes 661.65 mm long.

When RL1-RL2-RL3-RL4 are not energized a short piece of coax Y connects the NC contact of RL1 to the NC contact of RL2 and an equal length Y connects the NC contact of RL3 to the NC contact of RL4. The connecting coax Y is Teflon insulated UT141 semi-rigid cable and it is made 18.5 mm long just for mounting and soldering convenience (see Photo 3). Y1 is a delay line made of UT141 coax and it is cut for $1/4 \lambda_e$ at 435.0 MHz plus 18.5 mm for Y.

Since the velocity factor V_f of Teflon is 0.694, the full length of Y1 becomes $138.15 + 18.5 = 156.65 \text{ mm}$. When RL1 and RL2 are energized, a delay line with an effective length $Y1 - Y = 138.15 \text{ mm}$ is added into the circuit of coax X1 feeding the rear dipole.

Y2 is a delay line made of UT141 coax and it is cut for $1/2 \lambda_e$ plus 18.5 mm for Y and the full length of it at 435.0 MHz is $275.31 + 18.5 = 293.81 \text{ mm}$ so that when RL3 and RL4 are energized a delay line with an effective length of $Y2 - Y = 275.31 \text{ mm}$ is added into the circuit of coax X2 feeding the front dipole.

Using this arrangement the whole length of branch RL1+Y+RL2 is the same of branch

RL3+Y+RL4. The internal length of the relays plus that of the joining coax Y do not change the effective electrical length λ_e on delay lines Y1 and Y2 because switching the system to any polarization mode, as shown in Figure 1, the same common length of 18.5 mm for coax Y is entered into the circuit of X1 and X2 in any switching condition when relays are energized or not energized.

The impedance of each branch at the common port C1 of relay RL2 and port C2 of relay RL4 is very close to $50 + j0 \text{ ohms}$ (return loss > 26 dB at 435.0 MHz) and the simpler light weight matching method to feed the switcher to a 50 ohm transmission line down to a transceiver was to transform the impedance of each branch from 50 ohms to about 112 ohms by means of a $1/4 \lambda_e$ matching lines Z1 and Z2 made with 75 ohm RG-302 PTFE coax with $V_f = 0.694$ and each matching line at 435.0 MHz is 119.65 mm long.

Both impedances, $112 + j112 \text{ ohms}$, are then connected in parallel in C3 and the resultant impedance at the antenna feed point becomes again approximately 50 ohms.

Referring to Figure 1, the rear dipole B-B' and the front dipole A-A' are spaced in free space along the boom by $1/4 \lambda_0$. Looking the dipoles standing behind the antenna as indicated in the drawing we see that the center lead of X1 feeding the rear dipole B-B' is connected to side B' for a rear observer while the center lead of X2 feeding the front dipole A-A' is connected to side A and it is anticipated that the indicated polarizations of H-V-RHCP-LHCP in this switcher can be generated only if the above mentioned connections of the coax center leads to the dipole studs as seen from the back reflectors are made according to Figure 1.

The letters B-B' and A-A' at the tips of both dipoles in Figure 2A allow us to compute the direction of the electric field at the center P of the front driven element using the very comprehensive method suggested in "The Satellite Experimenter's Handbook", pages 7-11, Chapter 7, written by Martin Davidoff, K2UBC, [3].

To easily visualize

how the linear and circular polarizations are generated, the rear dipole B-B' in the drawing Figure 2A is represented horizontally and the front dipole A-A' vertically, but in real operation, to show the horizontal and vertical polarizations, the elements of the antenna must be oriented 45 degrees to the boom in X configuration as in Figure 1 or in Figure 2F. More on this will be discussed later.

Horizontal Polarization (H)

When RL1-RL2-RL3-RL4 are not energized, the branch $Z2 + RL4 + Y + RL3 + X2$ is $1/4 \lambda_e$ longer than $Z1 + RL2 + Y + RL1 + X1$ and, as shown by the diagram in Figure 2B, the RF current feeding the front dipole A-A' is supplied with a lag of 90° with respect to the current feeding the rear dipole. Looking from the back of Figure 2A in the direction of forward gain with the aid of Figure 2B and Table 1 in Figure 2, we see that during one cycle of the RF current, the rear dipole B-B' at time 1 shows the maximum field at 3 o'clock. Since the front dipole A-A' is supplied with a delay of 90° , Table 1 shows that at time 1 the field in A-A' is zero but at time 2 it rises to maximum at 12 o'clock.

Focusing our attention at time 2 when the field in front dipole A-A' is maximum at 12 o'clock, we note that the field that was maximum at time 1 and 3 o'clock in the rear dipole B-B' is actually propagated through free space in direction of the front dipole A-A' arriving after $1/4$ of a RF cycle at time 2 in the same plane P in which the front dipole A-A' lies. (See Table 1 in Figure 2A.)

As a consequence at time 2 in point P we have 2 fields linearly polarized with the same magnitude at 3 and 12 o'clock and the contribution of the above components is a resultant field which vector is oriented at 45 degrees to the dipoles as shown in Figure 2C and by the arrow in the last column P of Table 1.

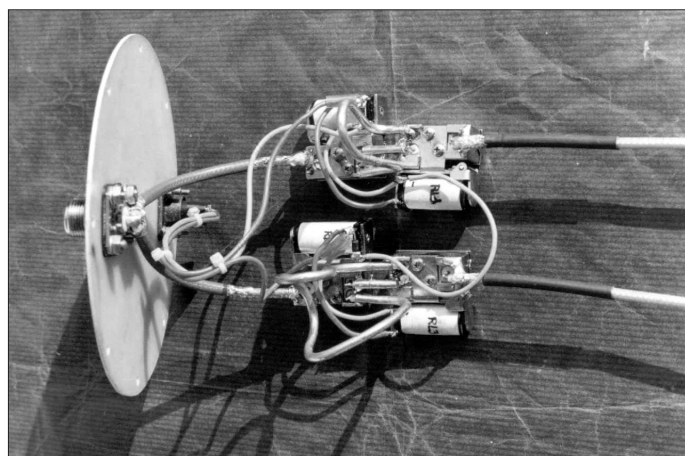


Photo 3

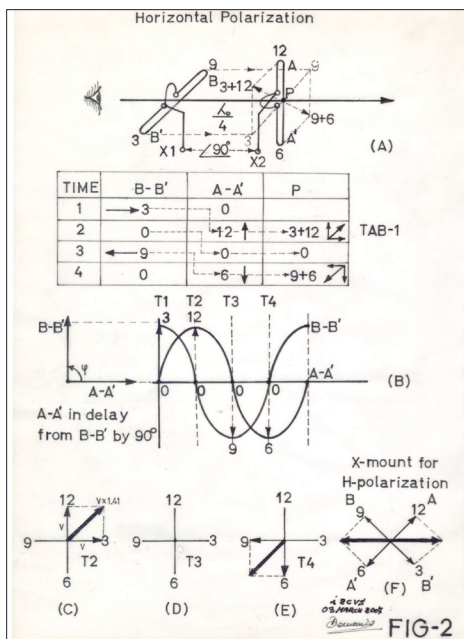


Figure 2: Horizontal polarization mode.

The magnitude of the voltage of this resultant field is 1.41 times that of the voltage V of each component because the power that was equally split in two parts between the driven elements is actually available in the field of the resultant vector (see Figure 2C and 2E). As a consequence, the power capability of this switcher is 300 watts because the maximum power permitted for a relay CX 120 P in each branch is 150 watts.

Since the elements are not cross-mounted but are X mounted as in Figure 2A over the boom as in Figure 1 or in Figure 2F it follows that when the antenna is in operation, the resultant vectors in Figures 2C and 2E are rotated by 45° clockwise with the boom and as shown in Figure 2F, the radiated field becomes horizontally polarized (H).

Vertical Polarization (V)

When only RL3 and RL4 are energized, the delay line Y2 is switched into circuit and the branch $Z2+RL4+Y2+RL3+X2$ becomes $3/4 \lambda$ longer than $Z1+RL2+Y+RL1+X1$ and so, as shown in Figure 3B, the RF current feeding the front dipole A-A' is supplied with a lag of 270° with respect of the current feeding the rear dipole B-B'. That is to say that the current feeding A-A' leads by 90° the current feeding B-B'. Table 2 in Figure 3 shows the direction and magnitude of maximum field in dipoles B-B' and A-A' at each of the times 1-2-3-4 as every quarter cycle has elapsed for the currents in the diagram Figure 3B.

Focusing our attention at time 2 when the field in front dipole A-A' is maximum at 6 o'clock, we note that the field that was

maximum at time 1 and 3 o'clock in the rear dipole B-B' is propagated through free space in the direction of the front dipole A-A' arriving after 1/4 of an RF cycle at time 2 in the same plane P in which the front dipole A-A' lies (see Table 2). Thus, a linear resultant field from components at 3 and 6 o'clock is actually generated at -45° as indicated by the resultant vector in Figure 3C and by the arrows in the last column P of Table 2. Rotating the boom in Figure 3A by 45° clockwise makes the elements physically mounted in an X configuration as in Figure 3F so vertical polarization (V) is produced.

Right Hand Circular Polarization (RHCP)

When only RL1 and RL2 are energized the delay line Y1 is switched into circuit and the length of branch $Z1+RL2+Y1+RL1+X1$ becomes the same as branch $Z2+RL4+Y+RL3+X2$ and so, as shown in Figure 4, the RF currents feeding the driven elements B-B' and A-A' are supplied in phase and $\phi = 0$ degrees.

Following Table 3 in Figure 4, we start our observations at time 2 when the RF current is producing at the same time a maximum field at 3 o'clock in the rear dipole B-B' and at 12 o'clock in the front dipole A-A'. Time 3 occurs after a quarter-cycle has elapsed when the RF current in both driven element is zero.

In the last column by vectorially adding together, we fill for each time the field at the center of A-A' and the field that was produced at the center of B-B' a quarter

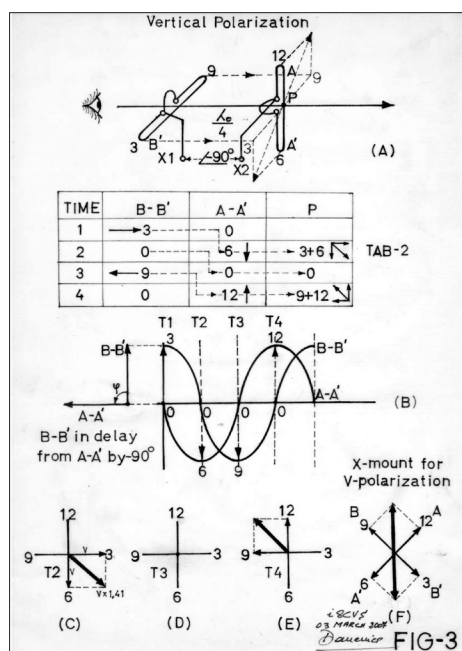


Figure 3: Vertical Polarization mode.

of a cycle earlier which is just reaching P. Standing behind B-B' from our observation point in back of the antenna in Figure 4A and looking in the direction of maximum gain, we see the resultant vector of the electric field generated at point P rotate from 12 o'clock to 3 o'clock during a quarter cycle of the RF currents and therefore as shown in Figure 4C-D the wave rotating clockwise is right hand circularly polarized (RHCP).

Left Hand Circular Polarization (LHCP)

When all relays RL1-RL2-RL3-RL4 are energized, both delay lines Y1 and Y2 are switched into circuit but since Y2 is $1/4 \lambda$ longer than Y1, only the resultant difference $Y2-Y1$ corresponding to an effective delay line $1/4 \lambda$ or 119.65 mm long is added in circuit to coax X2 feeding the front dipole A-A'. In this condition the branch $Z2+RL4+Y2+RL3+X2$ is $1/2 \lambda$ longer than $Z1+RL2+Y1+RL1+X1$ and as shown in Figure 5B the RF currents feeding the driven elements B-B' and A-A' are supplied in anti-phase i.e., 180° out of phase.

With the aid of Table 4 in Figure 5 we start our observations at time 2 when the RF current is producing a maximum field at each driven element and looking at the last column of Table 4 remembering that the contribution of element B-B' at point P was actually produced by B-B' a quarter-cycle earlier, we see that the resultant electric vector at point P as seen from the back of the antenna in Figure 5A, rotates from 6 o'clock to 3 o'clock, i.e., by 90° counterclockwise

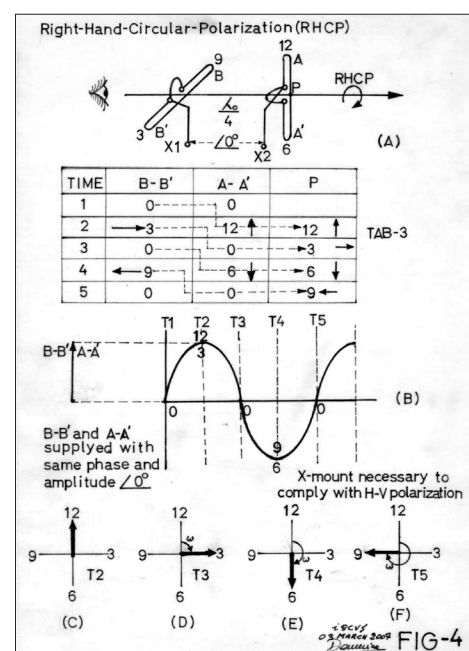


Figure 4: Right-Hand-Circular Polarization.



during one quarter-cycle of the RF currents and therefore, as shown by the arrows in the last column P of Table 4 and by the vectors in Figures 5C-D-E-F, we see that the wave is left hand circularly polarized (LHCP).

Switching Polarizations

Switching H-V-RHCP and LHCP from the shack is accomplished using only a three-conductor wire with a single pole, four-position switch and four 1N4007 diodes. The schematic diagram in Figure 6 is self-explanatory and the diodes D3, D4 across the coils are used only to shunt the inductive kickback generated during circuit opening.

Polarization	Relays Energized
Horizontal	-----
Vertical	RL3 + RL4
RHCP	RL1 + RL2
LHCP	RL1 + RL2 + RL3 + RL4

For maximum contact life of the coax relays it is mandatory that polarization is not switched while transmitting, particularly when using high power. This practice is valid for any type of polarization switcher unless a suitable interlock between the switcher and transmitter is included.

Changes Using Different Antennas

Another good candidate antenna for this switcher is the Cushcraft 738XB because the folded dipoles are physically spaced by $1/4 \lambda_0$ over the boom and the $1/2 \lambda_e$ 4:1 coax balun is supplied so that the above antenna can be immediately adapted to work with this switcher provided that both folded dipoles are connected to feed-lines X1 and X2 according to Figure 1.

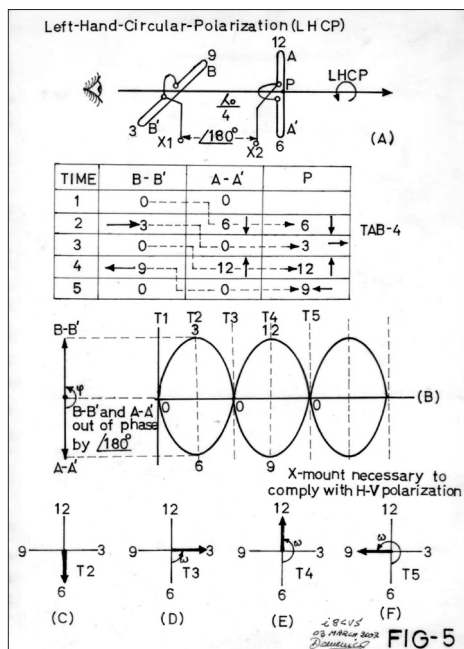


Figure 5: Left-Hand-Circular Polarization.

If the driven elements of a candidate antenna are spaced $1/4 \lambda_0$ over the boom but they are matched to a 50 ohm feed line using a gamma match, then a balun is not required in an unbalanced matching system and, with reference to Figure 1, the gamma arm must be oriented in direction of tip A for the front dipole and in direction of tip B' for the rear dipole while the braid of the coax cable must be grounded in the usual manner to the center of each element and to the boom.

If the driven elements are spaced by $1/4 \lambda_0$ over the boom and they are matched to a 50 ohm feed line by a T-match, which is a balanced matching system, then a balun with a suitable impedance ratio between the impedance of the driven element and 50 ohms is required and both arms of the T-match must be connected to X1 and X2 according to the orientation of tips A and B' on folded dipoles Figure 1.

If the driven elements are close spaced over the boom by a distance $D < 1/4 \lambda_0$ then the length of the coax line X2 must be equal to $X1 + (D \times V_f)$.

Example:

The center-to-center dipole spacing of an early design 10 + 10 element crossed Yagi built by Cushcraft is $D = 18$ mm over the boom. The equivalent length for the RG-303 coax cable is $D \times V_f = 18 \times 0.694 = 12.49$ mm

$X1 = 542.0$ mm for reference
 $X2 = 542.0 + 12.49 = 554.49$ mm

If instead the driven elements are spaced over the boom by a distance $D > 1/4 \lambda_0$, then the actual length of coax line X2 must be increased by a quantity equal to $(D - 1/4 \lambda_0) \times V_f$

Example:

The folded dipole spacing of a Tonna 2 x 19 element crossed Yagi model 20438 is $D = 199.4$ mm over the boom. This spacing is greater than a free space $1/4 \lambda_0$ that is 172.4 mm at 435 MHz and so:

$(D - 1/4 \lambda_0) \times V_f = (199.4 - 172.4) \times 0.694 = 18.74$ mm

Line $X2 = 661.65 + 18.74 = 680.39$ mm including the length of the N male connector

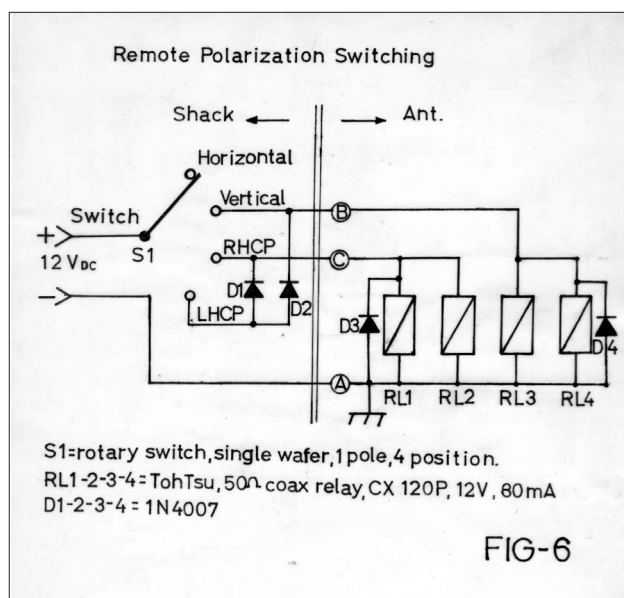


Figure 6: Remote switching circuit.

and obviously X2 must be connected to the front dipole.

Note that the folded dipoles of the above antenna are matched to 50 ohms by a strategic distance from the first director so that they can be directly connected to a 50-ohm coax line. However, for unknown reasons in spite of the balanced feed point in the folded dipole, no balun has been used by the manufacturer. Anyway, the folded dipole uses N connectors encapsulated into a black plastic body carrying a small bump indicating for reference the side of the dipole which is connected to the connector body and hence to the coax braid. As a consequence the side of the dipole opposite to the above bump is the hot side of the dipole connected to the inner pin in the N connector and so the above hot side must be oriented in X-mount configuration to comply with tips A and B' in Figure 1.

Note: The second part of this article in the next issue will deal with construction and testing of the switcher.

References

- [1] "A Remote Polarization Switching Unit for Crossed-Yagi Antennas" by H. Stoll, DF7SO, VHF Communications, 1/1980
- [2] "Notice sur la Polarization Circulaire sur 144/146 MHz et 432/438 MHz", by F9FT http://f5ad.free.fr/QSP_Antennes/ANT-QSP_F9FT_polcircfr.pdf
- [3] *The Satellite Experimenter's Handbook*, by Martin Davidoff, K2UBC, ISBN 0-87259-318-5, ARRL Order No. 3185.
- [4] <http://www.g6lvb.com/fibermetalboom.htm>



2006 AMSAT Symposium and Meeting

Gould Smith, WA4SXM, wa4sxm@amsat.org

For six days in early October 2006 about 160 of the AMSAT faithful assembled south of San Francisco in San Mateo, CA for the AMSAT BOD meeting, annual Symposium and an International ARISS meeting. All these events are mind expanding, enjoyable and can be had for a vacation day and a few hundred dollars. For those that are interested in amateur satellites, the Symposium is a must attend event. Since I attended my first Symposium in Atlanta 1988, I have this event on my calendar every year. Not only do you see how AMSAT operates, but also you get to talk with the people that make it operate. The presentations are extraordinary and you learn things that are key in the decision making process. There is also the opportunity to discuss your ideas with the decision makers. If you cannot be there, you should order the Symposium Proceedings. This year has an especially large number of very informative papers. Get yourself a copy and plan on being at the next Symposium in Pittsburgh, late Oct 2007.

BOD Meeting

The 2006 AMSAT Board of Directors meeting was held for a day and a half before the annual Symposium in the same hotel. This change from after the Symposium has been well received and expected to continue. The major items discussed were: welcoming of new board members; changes in the AMSAT officers; fund raising; approval of Eagle frequency bands and operational modes; declaration of increased support for AMSAT's great resources - AO-51, AO-16 and AO-7; cooperative agreement with University of Maryland Eastern Shore; relocating the AMSAT lab to a facility near

Wallops Island; 2007 budget and goals. The 2007 Symposium will be held in Pittsburgh, 26-28 October 2007, mark your calendars.

Friday, 6 October 2006 Afternoon Talks:

PCSat2, ANDE, Raft and Psat Satellites; Bob Bruninga, WB4APR

The Naval Academy has launched its 3rd, 4th and 5th educational satellites from Kennedy in December 2006. These satellites follow on to the successful missions of PCSAT-1 and PCSAT2 which provided communications support for a variety of student satellite and space communication experiments.

An EZ-Lindenblad Antenna for 2 m; Anthony Monteiro, AA2TX

This paper offers an easier way to construct a Lindenblad antenna by making use of a novel, yet simple, feed mechanism that dramatically simplifies the antenna construction. The four, driven dipoles are fed with ordinary 75-ohm coaxial cables that are all soldered to a single N-connector with no matching sections or transformers.

Analysis of Maximum Elevation Pass Profiles; Gould Smith, WA4SXM

What effect does your location have on the maximum elevation profile for the AO-51 satellite? A profile of the maximum elevations taken for six months for AO-51 at different locations was compiled and compared. The question is do different locations have different profiles and are some more favorable or less favorable?

A Parasitic Lindenblad Antenna for 70 cm; Anthony Monteiro, AA2TX

This paper introduced a novel and considerably simpler way to construct

a "Lindenblad" style antenna. It uses a single, dipole, driven-element along with a passive, parasitic, circular-polarizer. While technically not a "Lindenblad," the antenna radiation pattern is nearly identical and the single driven dipole provides an excellent match to 50-ohms across the 70 cm band.

Old Dogs – New Tricks; Nick Pugh, K5QXJ

This presentation was a demonstration of two freeware programs to accomplish schematic capture and printed circuit board layout. The use of this software will allow amateurs with very limited experience to design and purchase printed circuits board for less than \$55. Nick demonstrated the layout of a UHF preamp using surface mount components that allow printed circuits to be ordered with two day delivery. His presentation included a cursory tutorial on surface mount devices and the tools needed to populate a PCB.

History and Tradition of HF Nets; Keith Pugh, W5IU

History of how the AMSAT News Service relayed information across the country and around the world from the early days until the present. Emphasis is on the HF Nets – the bands, the people and the information. The question is raised: Do we still need them today?

The Design of Eagle Modules; Dick Jansson, WB4FAB and Bob Davis, KF4KSS

The experience gained in working with the AO-40 electronic modules has governed the creation of the modules for the Eagle spacecraft. This design has been created independently of the actual spaceframe

AMSAT Board of Directors meeting in progress.





AMSAT Officers for 2007 (l-r): Gunther Meisse, W8GSM; Barry Baines, WD4ASW; Lee McLamb, KU4OS; Emily Clarke, N1DID; Lou McFadin, W5DID; Drew Glasbrenner, KO4MA; Bob McGwier, N4HY; Tom Clark, K3IO. Not shown is Rick Hambly, W2GPS.

design as any spacecraft will be made to accept these modules.

Another SUNSAT; Hans van de Groenendaal, ZS6AKV

Soon South Africa will get another voice in the sky when its second satellite, named Sumbandila (freely translated into English "Pathfinder") is scheduled for launch in the Spring of 2007. It means showing or pointing the way.

KiwiSat – A ZL Communication Satellite; Ian Ashley, ZL1AOX

KiwiSAT is a MicroSAT class satellite designed and built by AMSAT-ZL (New Zealand). This paper reviews its construction progress.

A NB FM Exciter for AO-51 Uplink; Bill Ress, N6GHZ

Bill has designed an exciter board for a single frequency, 1.268 GHz uplink to better utilize the L-band capability on AO-51. The 50 mW output can then be amplified up to 3W and then up to 30W. This power level into a +14.5 dB antenna will provide about 600 W EIRP, more than adequate to get into AO-51.

Frequency Coordination 101 Training Session; Art Feller, W4ART

Art led a session explaining many of factors that go into determining the best frequency recommendations for new satellites.

Saturday, 7 October 2006:

Low Cost Ground Station Design; Tarun Tuli, VA3TST, and Nathan Orr, VE3NGO

This paper deals with the design and implementation of a fully capable ground station used to facilitate communications for nanosatellite missions. Nanosatellite

missions by their very nature follow a philosophy of a low cost and rapid development cycle and as such the ground station design is constrained to fall within this same framework.

Eagle Program Introduction and Update; Jim Sanford, WB4GCS

Jim presented an update of the overall Eagle project and introductions to specific talks about Eagle subsystems.

Antenna Arrays 1 - Theory and Factoids; Tom Clark, K3IO

Although not part of his paper, Tom presented an outstanding primer on spectral analysis to segue into his antenna theory presentation.

Some Theory and Factoids - Future AMSAT missions will use "smart" antenna arrays to achieve the gain needed for solid links to the ground. In this paper he described the underlying theory that can be used to predict performance of an array. Since the theoretical basis involves some math, he attempted to demystify arrays and provide some simple rules-of-thumb. In the discussion, he demonstrated the similarity between time-frequency spectrum analysis and antenna arrays. Just as we have learned in all our SDR activities, time (seconds) and frequency (cycles/second) are related by Fourier transforms. The antenna pattern (i.e. power as a function of angle) on the sky is related to the "spatial frequencies" that describe the illumination of the antenna. These concepts were explained with practical analogies.

Antenna Arrays Part 2 - Application to Eagle; Tom Clark, K3IO

Applications to Eagle – Based on this brief exposure to array theory, he used the concepts introduced in Part 1 to describe

possible implementation for the Eagle spacecraft. Eagle will be a spin-stabilized spacecraft; as the satellite moves away from apogee, the "antenna farm" will no longer face the earth. In professional 3-axis stabilized satellites, the antenna platform might be mechanically pointed to maintain the antenna pointing at the earth; but AMSAT prefers to move electrons instead of metal. We have designed phased array antennas that can steer the beam with no moving parts. Some of the possible array configurations and present MATLAB simulations of the beam patterns that the user can expect were described.

Software Radios, an Enabling Technology; Courtney Duncan, N5BF/6

Radios such as the SDR-1000, DSP-10 and others, where general signal processing is handled by software (and is thus "infinitely" configurable and adaptable), open vast new frontiers of possibility in amateur space communications. This paper describes the author's experience with the DSP-10 2 m radio construction, programming and operation including satellite tracking, QRPp moonbounce and even contesting. Further ideas for developments to the benefit of the amateur satellite service and Amateur Radio operators are presented.

Application of SDR Techniques; Howard Long, G6LVB

The rapid development of Software Defined Radio (SDR) techniques over the past few years, primarily for use in terrestrial applications such as cellular telephony and wireless LAN technology, has practical applications in satellite transponders. This article describes the recent progress and application of these techniques.

A Proposed Eagle Digital Comm Payload; Matt Ettus, N2MJI

A proposed communication system for the AMSAT Eagle Digital Communications Payload (DCP) downlink is described. The C-Band downlink must accommodate varying classes of users with antennas ranging from 60 cm to 2 m dishes and varying data rates from 4800 bps to 256 kbps. The system will handle multiple downlink streams at each rate, for an aggregate throughput in the range of 500-750 kbps.

Stanford University's Small Satellite Program; Professor Bob Twiggs, KE6QMD

Bob brought us up to date with the activities at the Stanford Small Satellite Program. He



has also started a California wide program to mentor elementary classes in the science of space.

Peter I DXpedition Experiences; Gordon Hardman, W0RUN

Gordon gave an exciting audio/video presentation and commentary on the preparation, travel, setup, operation and take down of the daring Peter I DXpedition, including satellite equipment and contacts.

Eagle and Erlang - Text Messaging; Frank Brickle, AB2KT

AMSAT Eagle will have a significant capability for text messaging among minimal ground stations. The plan is to use XMPP (originally known as Jabber) as the protocol. The best available platform is implemented using Erlang/OTP, a language

new, was described.

Amateur Satellite Spectrum; Paul Rinaldo, W4RI

This paper reviews the amateur satellite radio frequency spectrum, its origins, the status of allocations and possibilities for improvement. The amateur satellite service allocations ranging from 1260 MHz to 10.5 GHz are in trouble. Each band has a different story. This paper documents the situations in each of the amateur satellite bands and, where possible, provides conclusions and recommendations. It shows the international allocations as they appear in the International Telecommunication Union Radio Regulations along with footnotes related to amateur satellite service allocations. The relevant texts from the IARU Spectrum Requirements

document are included. Known threats to each band are shown.

I A R U Frequency Coordination; Hans van de Groenendaal, ZS6AKV

Following the increase in the number of organizations building and launching satellites operating on frequencies allocated to the amateur satellite service, various attempts were made to introduce a coordination

system. This led to the appointment of the IARU Satellite Adviser who is responsible to the IARU Administrative Council and charged with the task to work closely with AMSAT and other organizations to provide a coordination facility and a link to the IARU. This paper discussed the process and benefits to the satellite community afforded by the coordination committee.

A Report on SSETI-Express, SESO and ESMO; Graham Shirville, G3VZV

This presentation described the experience of launching the SSETI Express satellite in October 2005 from the perspective of being at the actual launch, seeing the high

level of the media and student interest and the tremendously valuable support received from radio amateurs around the world receiving and forwarding vital telemetry data immediately after launch. It also described the results of the flight analysis conducted by ESA and SSETI and give first details of the planned "Lessons Learnt" knowledgebase. The upcoming GTO ESEO mission, which is planned for a late 2008 launch and which will carry a linear U/S amateur transponder, was also discussed and, additionally, brief details of the ESMO moon orbiter plans were provided. SSETI - The Student Space Exploration & Technology Initiative

AMSAT General Meeting; Rick Hambly, W2GPS

Banquet and Keynote ISS Expedition 12 Cmdr. Bill McArthur, KC5ACR

After a very tasty dinner, the Commander of the ISS Expedition 12 crew, Bill McArthur, KC5ACR, fascinated the audience with pictures and stories of life aboard the ISS and his record setting Amateur Radio activities.

Sunday, October 8, 2006:

Field Operations Breakfast; Gould Smith, WA4SXM

Nearly a third of the Area Coordinators attended the breakfast. A year-end review of the Field Ops team accomplishments, ideas and goals for 2007 were discussed.

IARU Frequency Coordination Panel Discussion*; Hans van de Groenendaal, ZS6AKV

ARISS - 10 Years as a Team, 6 Years in Space; Frank Bauer, KA3HDO

Ten years of ARISS have raced by, just like a fast-growing sapling that soon turns into a healthy, enormous tree. It was not easy at first. The team needed to learn each other's cultures to thrive. ARISS has produced achievements in the technical field, the educational arena, on-air operations, public outreach events and international goodwill. In 1996, as the International Space Station neared initial hardware delivery, NASA asked the SAREX working group to spearhead an effort to bring together an international delegation to discuss the future of ham radio on ISS. The reason: to consolidate the many ham radio voices around the world into one voice - a team that would coordinate the development and operations of ham radio on ISS. The working group called ARISS, Amateur Radio on the International Space Station, was formed. This paper presents a retrospective from many who attended that



Tom Clark, K3IO, speaks to the attendees.

and operating environment designed for scalable telecommunications applications. Frank described the Eagle application, the Erlang implementation and the strong advantages that Erlang/OTP offers to general amateur satellite applications.

Changes in Attitude, Changes in Latitude; Bob McGwier, N4HY

An analysis of the spacecraft design to meet our mission needs has been underway for several months. We have partial results that show the previous Eagle proposal cannot meet our operational requirements. We have a concept that we hope will lead to a design. An analysis of the old, which leads to the



first meeting in Houston or were pivotal in the development of the ARISS team.

SuitSat 2; Frank Bauer, KA3HDO

Frank brought us up to date with the current SuitSat 2 planning and the proposed payloads. SuitSat 2 is expected to have

for energy storage, and the challenges associated with the design.

Amateur Radio and the CubeSat Community; Bryan Klofas, KF6ZEO and Kyle Leveque, KG6TXT

This paper explores the relationship between

leading up to the event including classroom demonstrations, visual sighting parties, classroom to classroom conversations on HF, Parrott Repeater in the classroom and on Sunsat, model rockets, etc. On the day of the event we utilized everything available: HF for schedules with a Space Museum, with an Astronaut, and with Steve Ford at W1AW; Arrow Demos on LEO Birds; receipt of world wide traffic on digital birds (requested prior to the event); and SSB QSOs on LEO birds. The main purpose of the paper is to illustrate the many possibilities for use of satellites in the classroom. It should be pointed out that this was aimed at Grades K-5 with major emphasis on Grades 1-3.

Emerging Launch Opportunities; Lee McLamb, KU4OS

Finding opportunities to launch is a primary challenge faced by AMSAT as well as the entire small satellite community. This paper reviews additional capabilities that are emerging in the form of new launch vehicles, new launch sites as well as new multiple and secondary payload adapters for existing vehicles.

Sunday Afternoon Trip to Ames Research Center

We were treated to a very interesting presentation by Dr. Scott Sandford about his participation in Project Stardust, the comet studying spacecraft that made a successful round trip to a comet and back. Dr. Sandford works at the Astrophysics Branch at NASA's Ames Research Center and is a renowned expert in the field of meteoritics, the study of rocks that fall from space. On February 7,



ISS Expedition 12 Commander Bill McArthur, KC5ACR (l), with Sergey Samburov, RV3DR (c), and Frank Bauer, KA3HDO (r), answers questions following his banquet talk. Seated at left is Emily Clarke, N1DID, AMSAT BoD member.

solar cells and an SDX (software defined transponder), as well as voice messages. An ISS crew could launch SuitSat-2 during a spacewalk as early as October of 2007, in conjunction with the 50th anniversary of Sputnik-1.

A New Approach to Satellite Power Systems; Lou McFadin, W5DID

While most, if not all, earth orbit satellites are solar powered, batteries are still a necessary part of the power system for bridging the power gap while the satellite is in eclipse. Unfortunately, this reliance on a chemically based storage system has several problems. The battery's capacity is reduced with age and use, output voltage drops as they discharge and stacking the cells for higher output voltage can lead to premature aging and failure due to unequal charging. An alternate solution is to use individual ultra-large capacitance (> 200 Farads) capacitors for storage. These super capacitors have the capability to; undergo tens of millions of charge/discharge cycles without degradation, charge at currents up to 5000 amps, and using a simple bi-directional switching circuit, individual capacitors can charge from, and power, almost any voltage bus. This paper discusses the design of a power system using these super capacitors

the AMSAT and CubeSat communities, including gained educational experiences, collaboration on an International Ground Station Network, and future Amateur Radio payloads on CubeSats.

Space Day At The Riverside ALC; Keith Pugh, W5IU

This paper describes the activities on the day of the event and all of the activities



Walt Wittenberg, K0CEH (l), studies one of the panels in the ISS exhibit at the Ames NASA Exploration Center.

1999, Stardust lifted off on its long journey. Five years later, on January 2, 2004, it successfully caught up with comet Wild-2 and flew within 150 miles of the nucleus, collecting particles and snapping detailed photographs of the comet's pockmarked surface. The next step was to return to earth and to re-enter the Earth's atmosphere. On January 15, 2006 the Stardust capsule survived an intense 80-mile plunge through the atmosphere that would destroy most objects its size. Dr. Sandford was in the Utah desert for the successful recovery. He also told the group some of the preliminary findings about the makeup of the captured dust.

ARISS International Delegates Meeting; Monday and Tuesday, Oct 9 & 10, 2006

This was the second time that the ARISS International meeting was held in conjunction with the AMSAT Symposium and this has proven to be a good pairing. Officers were re-elected, SuitSat 1 was discussed and SuitSat 2 was approved with many enhanced features. Once again the timeline is short with an anticipated launch in the fall of 2007. Expedition 12 Commander Bill McArthur attended, as did his wife Cynthia, who presented a report on the activities of the NASA Education Office. The 2007 ARISS meeting will be hosted by ARISS Russia in conjunction with the 50th anniversary of the launch of Sputnik-1.

2006 AMSAT Awards

The following people have been recognized by AMSAT for their invaluable contribution in 2006.

Executive Team

Mike Kingery, KE4AZN
Martha Saragovitz
Barry Baines, WD4ASW
Gunter Meisse, W8GSM
Bob McGwier, N4HY
Frank Bauer, KA3HDO

Field Ops Team

Drew Glasbrenner, KO4MA
Karl Sandstrom, K5MAN
Keith Pugh, W5IU
Robert Davies, KI4HXT
Dee Interdonato, NB2F
Emily Clarke, N1DID
Ernie Bauer, N1AEW

Engineering Team

Matt Ettus, N2MJI
Lyle Johnson, KK7P
Chuck Green, N0ADI

Howard Long, G6LVB
Frank Brickle, AB2KT
John Stephensen, KD6OZH
Jan King, VK4GEY
Dick Jansson, WD4FAB
Stephen Hendrickson
Tom Clark, K3IO
Eric Elison, AA4SW
Jim Sanford, WB4GCS

AO-51 Command Team

Drew Glasbrenner, KO4MA

Website Team

Eric Christensen, KF4OTN
Bill Greene, VE7WFG
Emily Clark, N1DID

ARISS Team

Mark Steiner, K3MS
Carol Jackson, KB3LKI
Deanna Lutz, K7DID
Steve Dimse, K4HG
A.J. Framer, AJ3U
Richard Crow, N2SPI
Bob King, VE6BLD
Sergey Samburov, RV3DR
Emily Clarke, N1DID
Hiroto Watarikawa, J1LYU
Farrell Winder, W8ZCF
Jeffery Winder, KB8VCO
Herb Sullivan, K6QXB
Al Bloom, N1AL
Stan Wood, WA4NFY
Fred Parker, KF0AK
Kenneth Ransom, N5VHO
Joe Juliher, N9MXU
Steve Bible, N7HPR
Lou McFadin, W5DID

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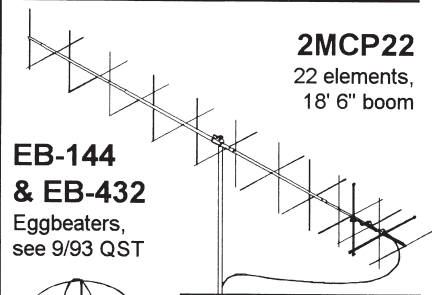
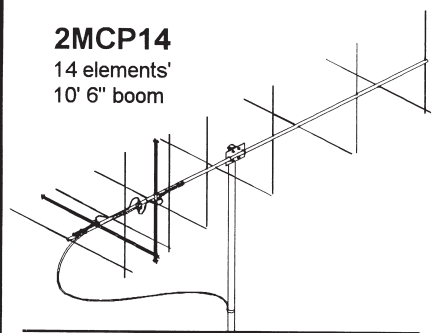
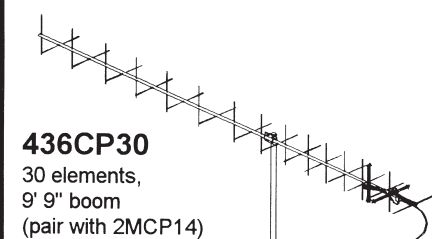
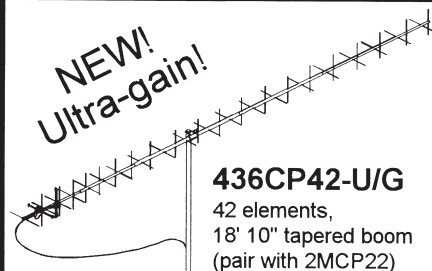
Gould Smith, WA4SXM
Ed Long, WA4SWJ
Paul Williamson, KB5MU
JoAnne Maenpaa, K9JKM
Bruce Paige, KK5DO
Deanna Lutz, K7DID

Symposium Team

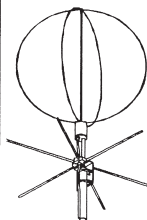
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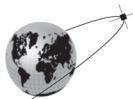
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(SDX) design is progressing, as is the UHF receiver design. There has been much discussion regarding the design of steered antenna arrays for S2 and C-bands to support the Advanced Communications Payload.

There is a plan under consideration to build a scale model of the new Eagle structure for display at Dayton. I would like this to be full size but we aren't sure where to put such a large model. We will also have demonstrations of the SDX and other Eagle technologies at Dayton. This would be a good year for you to come and see what we have accomplished.

AMSAT Lab

The new AMSAT lab in Pocomoke City MD is rapidly becoming a reality. The equipment and parts have been unpacked and inventoried. Additional equipment that has been in storage around the country is being retrieved and sent to the new lab.

The massive (20'x20') clean room is nearly ready to be assembled after weeks of cleaning, scraping and painting. By the time you read this I expect the clean room structure and air handlers will be assembled. We need to purchase new air filters, walls and skirts at a cost of about \$15,000 so please remember that AMSAT needs donations from you, your local ham club, your company and any other source you can think of. Building satellites is an expensive enterprise.

AMSAT Needs You!

AMSAT needs your support to achieve our goals. Our Eagle satellite project is ramping up and our commitment to P3E is substantial. Please call the AMSAT office or visit the AMSAT Web Store to make your donation to keep us going. Donations of \$120.00 or more qualify for President's Club status.

For information on setting up a hamfest AMSAT booth or giving presentations at local ham clubs contact Martha at the AMSAT office (301) 589-6062 or your AMSAT Field Operations Director, Gould Smith, WA4SXM, at wa4sxm@amsat.org.

73,
Richard M. Hambly, W2GPS
AMSAT President

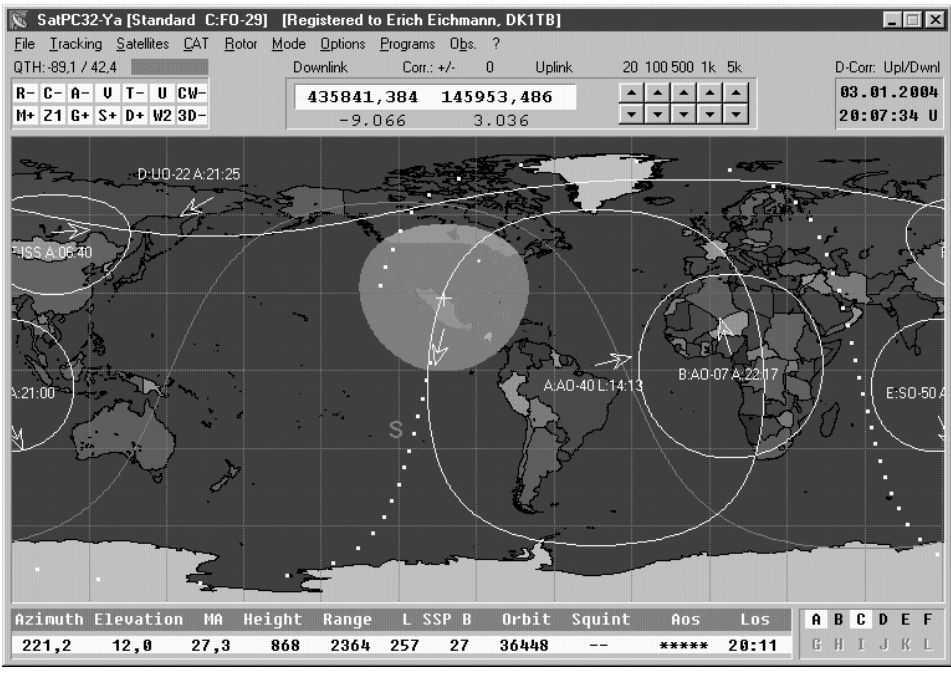
AMSAT is the North American distributor of **SatPC32**, a tracking program designed for ham satellite applications. For Windows 95, 98, NT, ME, 2000, XP.

Version 12.4 now supports Labjack U12 and W0LMD rotor controllers and Doppler tuning for Yaesu FT-817/857/897.

Features:

- Version 12.4 also supports automatic Internet download of Keplerian elements.
- Graphical tracking on a world map with two selectable Zoom factors.
- One-click satellite switching using 12 "letter" buttons.
- Automatic rotor control support for: Kansas City Tracker/Tuner, FODtrack, Uni_Trac, SatEL, Labjack U12/Piggyback, W0LMD Mini/Junior/Senior Trackers, Yaesu GS-232, ARS from EA4TX, EGIS rotors, IF-100, RIF-PC, AMSAT-DL interface, WinRotor32, HalloRotor, and WiSP DDE clients.
- Doppler tuning with on-screen frequency displays. Radio models supported: Yaesu FT-847, FT-736R, FT-817, FT-857, FT-897 ICOM IC-820H, IC-821H, IC-910H and other ICOM radios Kenwood TS-790 and TS-2000 DDE client programs
- "Transparent" VFO-knob tuning in addition to keyboard and mouse tuning.
- "Virtual" VFO tracking for half-duplex transceivers FT-817, FT-857, FT-897.
- Includes a special version for ISS split-frequency operation.
- Controls subaudible tone on FT-847, FT-736R, FT-817/857/897, and IC-910H.
- Includes a non-graphical version and programs that output lists to the screen, printer, or a file.
- Interfaces with WiSP, with user-defined satellite switching priority.
- Includes a separate program for tracking the Sun and Moon.

Price is \$45 for AMSAT members, \$50 for non-members, on CD-ROM. A demo version may be downloaded from <http://www.dk1tb.de/indexeng.htm> A registration password for the demo version is \$40 (members), \$45 (non-members). Order by calling 1-888-322-6728, or use the online shop at www.amsat.org. The author DK1TB donated SatPC32 to AMSAT. All proceeds support AMSAT.

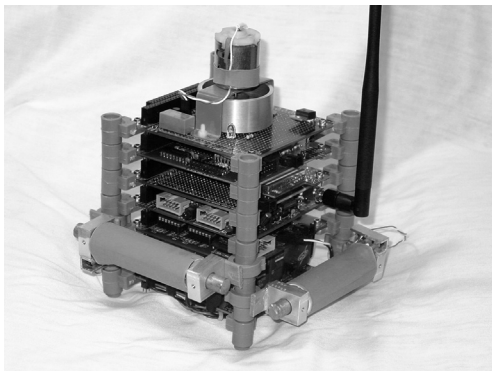


New in the AMSAT Store!

AMSAT is proud to offer this quality white polo shirt made of 100% combed cotton by Outer Banks for 2007. The shirt is short sleeve and has a collar and three buttons. A pocket is on the left. Appearing directly above the pocket is the AMSAT logo and name in red and Radio Amateur Satellite Corporation in blue. This shirt comes in medium, large, extra large, 2X large and 3X large. Quantities are limited. ☎



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AMSAT/TAPR Banquet at Dayton 2007

We are pleased to announce the first AMSAT/TAPR banquet will be held Friday evening May 18, 2007 at the Air Force Museum in Dayton, OH in conjunction with the 2007 Dayton Hamvention. The two groups share many members and this gives everyone the opportunity to attend both events. The "Dinner Under the Wings" festivities will begin at 18:00 with a cash bar and appetizers in the Air Power Gallery (World War II). The buffet dinner will be served at 19:00 in the Cold War area. Following a few AMSAT and TAPR announcements, after dinner you will be free to roam the museum. The price for the dinner is \$35.00 per person and includes appetizers, salad, meal, dessert, coffee, iced tea, tax and gratuity.

See <http://afmuseum.com/> for information about the museum.

The museum will close at 22:00 and everyone must be out of the museum by then.

Vegetarian meals are available if selected when you purchase your ticket.

Reservations are required. The tickets can be purchased online at the AMSAT Store.

<http://www.amsat-na.com/categories.php>

There will be no banquet ticket sales at the AMSAT booth this year. We expect this to be a very popular event, so reserve your tickets early.

Reservations will close this year on Monday night, May 14, 2007 to allow us to give the museum a count on Tuesday.

There will be a special showing of the IMAX movie "Space Station" at 5:00 PM prior to

the banquet. This movie is approximately 47 minutes long and contains about 4 minutes of Amateur Radio contacts between school children and the International Space Station. The IMAX Theater is located in the museum building off the main lobby area. Attendees at the movie will be able to go to the banquet at 6:00 PM when the doors open about 10 minutes after the movie is over. The lobby contains restrooms, telephones and some seating. At least 50 people must sign up for the movie in advance. Call the museum IMAX theater on (937)-253-IMAX to make reservations. Special rates apply for children and seniors. Adults are \$6.00, seniors are \$5.50 and children 8 through college 22 (student ID required) are \$4.50.

Everyone is responsible for his or her own transportation to and from the museum. There will be no banquet speaker this year to give everyone a chance to view the exhibits.

Banquet Menu

Roll and Butter

Salad with choice of Ranch, French or Italian Dressing

Top Round of Beef w/carver

Classic Sautéed Chicken Breast in a Sun Dried Tomato Cream Sauce

Grilled Salmon Blackened with Jack Daniel's BBQ Sauce

Roasted Red Skin Potatoes

Rice Pilaf w/ Pine Nuts and Thyme

Prince Edward Blend w/Yellow Wax Beans, Green Beans and Baby Carrots

Sugar Snap Peas w/ Red and Yellow Peppers

Chocolate Chocolate Espresso Torte w/ berries and Melba Sauce ☎



The Orbital Classroom - Column #7

"New AMSAT Lab Completes First Satellite"

© 2007 by Prof. H. Paul Shuch, N6TX, n6tx@amsat.org
AMSAT Director of Education



The Orbital Classroom

Where would you build a ham satellite? At the dawn of the Space Age, OSCARs 1 and 2, the very first Amateur Radio satellites, were lashed together in the garages of a handful of dedicated San Francisco Bay Area hams. The next few OSCARs went together in more professionally equipped commercial laboratories, thanks to the generosity (and, in some cases, the ignorance) of various amateurs' employers. Still later, universities and colleges became home to satellite construction efforts, a trend that continues to this day. Still, for its most

AMSAT satellite integration activities enjoy a new home.

As reported earlier in this journal, AMSAT recently forged a productive partnership with the University of Maryland Eastern Shore (UMES), which resulted in our acquiring a spacious satellite lab. The arrangement is decidedly synergistic: AMSAT owns a clean-room, large enough to house our biggest satellites, which had long been in storage in Florida – but no place to set it up. UMES, on the other hand, occupies a large building a little South of Salisbury MD – but no clean room to set up there. The

agreement now in place allows UMES to house and use our clean room for their satellite projects, on a non-interference basis with AMSAT activities. This clearly benefits us all.

But wait, there's more! If you order now, in addition to the full set of Ginsu knives, you also get this unprecedented educational partnership ...

That's right. In the words of last winter's AMSAT press release: "The agreement with UMES calls for AMSAT-NA to work collaboratively with UMES to identify opportunities to work together on satellite and related technology projects as well as to work with their students and faculty to enhance hands-on studies and dissertation research. The possibility also exists for AMSAT-NA scientists and engineers to receive Adjunct status at

the UMES." In other words, we now have not just a new landlord, but also a new educational partner (hence, the inclusion of this item in the Orbital Classroom column).

So it happened that in January of 2007, three rented vans full of equipment drove north from Orlando, to join up with half a dozen AMSAT volunteers at the new facility in

Maryland. Our stated mission was to unload the trucks and start setting up our new lab. Only, given a spacious new facility, who can resist the urge to throw a satellite together? Certainly not AMSAT!

The inspiration for CoasterSat I came from the table amenities at the local restaurant where UMES and AMSAT volunteers gathered for dinner the evening before move-in day. Someone noticed that the square coasters upon which our (adult) beverages were placed measured roughly ten centimeters on a side. "Hey, that's the size of a CubeSat," your author opined. Thus, the rather large die was cast.

Since no Jedi or AMSAT away team ever goes anywhere without a roll of duct tape*, it didn't take long for CoasterSat I to take shape. Looking around the table for solar cells to line its exterior, our gaze fell upon a plethora of properly colored and appropriately sized artificial sweetener packets. A pair of six-inch coffee stirrers resonated conveniently as a Vee antenna for 70 cm. And, faster than you can say "orbital insertion," a new AMSAT bird was born! The result can be seen in the accompanying photographs. Though CoasterSat may never pass its vibration and thermal-vacuum chamber tests, this project speaks to the innovative spirit fostered within AMSAT and embraced by our educational partners in Maryland.

Our next effort, integration of the most capable Eagle satellite, may take just a little longer. Nevertheless, with the support and assistance of our academic partners, we are well on our way into orbit. UMES's students gain hands-on experience. We gain new orbital assets, and maybe, a few new hams along the way. Seems win-win to me. Clearly, the Force is with us.

* Duct tape is like the Force: it has a dark side and a light side and it binds the universe together.



CoasterSat I

ambitious projects, AMSAT has required a more formal Satellite Integration Facility to carry out the final phases of space hardware construction and testing. We've boasted two such facilities in our nearly three decade history, the first in the famous fishbowl at the NASA Goddard Spaceflight Center in Maryland, and later, another in a hangar on the Orlando Executive Airport. And now,



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- ARISS - Ten Years as a Team and Six Years in Space
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AMSAT at Hamfests



Mahana, W5BTS, and Bruce, KK5DO. Picture by Marty, WD5DZC, at the B-VARC hamfest at the Fort Bend County Fairgrounds on March 3, 2007.



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- ✓ A specially designed AMSAT President's Club Donor pin.

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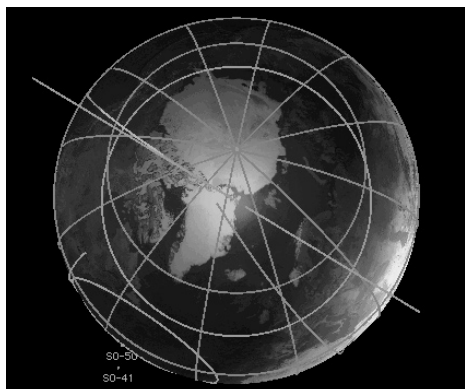
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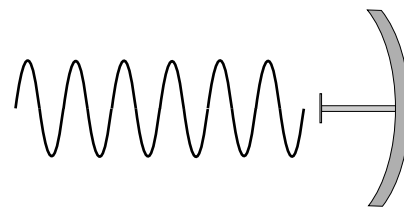
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2007 AMSAT Field Day Competition



It's that time of year again - summer and Field Day! Each year the American Radio Relay League (ARRL) sponsors Field Day as an emergency preparedness exercise. The event takes place during a 27-hour period on the fourth weekend of June. For 2007 the event takes place during a 27-hour period on the fourth full weekend of June, from 1800 UTC on Saturday, June 23, 2007 through 2100 UTC on Sunday, June 24, 2007. Those who set up prior to 1800 UTC on June 24 can operate only 24 hours. The Radio Amateur Satellite Corporation (AMSAT) promotes its own version of Field Day for operation via the amateur satellites, held concurrently with the ARRL event.

If you are considering ONLY the FM voice satellites like AMRAD-OSCAR-27, SaudiSat-Oscar-50 or AMSAT-OSCAR-51 for your AMSAT Field Day focus, don't, unless you are simply hoping to make one contact for the ARRL rules bonus points. The congestion on FM LEO satellites was so intense in prior years that we must continue to limit their use to one-QSO-per-FM-satellite. This includes the International Space Station. You will be allowed one QSO if the ISS is operating Voice. You will also be allowed one digital QSO with the ISS or any other digital, non-store-and-forward, packet satellite (if operational).

The format for the message exchange on the ISS or other digital packet satellite is an unproto packet to the other station (3-way exchange required) with all the same information as normally exchanged for ARRL Field Day,

e.g.:

W6NWX de KK5DO 2A STX
KK5DO de W6NWX QSL 5A SDG
W6NWX de KK5DO QSL

If you have worked the satellites on Field Day in recent years, you may have noticed a lot of good contacts can be made on some of the less populated, low-earth-orbit satellites like Fuji-OSCAR 29 or AMSAT-OSCAR 7. During Field Day the transponders come alive like 20 meters on a weekend. The good news is that the transponders on these satellites will support multiple simultaneous contacts. The bad news is that you can't use FM, just low duty-cycle modes like SSB and CW.

The 2007 AMSAT Field Day Rules

The AMSAT Field Day 2005 event is open to

all Amateur Radio operators. Amateurs are to use the exchange as specified in ARRL rules for Field Day. The AMSAT competition is to encourage the use of all amateur satellites, both analog and digital. Note that no points will be credited for any contacts beyond the ONE allowed via each single-channel FM satellite. Operators are encouraged not to make any extra contacts via these satellites (Ex: AO-27 & SO-50). CW contacts and digital contacts are worth three points as outlined below.

1. Analog Transponders

ARRL rules apply, except:

- Each phone, CW, and digital segment ON EACH SATELLITE TRANSPONDER is considered to be a separate band.
- CW and digital (RTTY, PSK-31, etc.) contacts count THREE points each.
- Only one contact is allowed via each single-channel FM satellite, AO-27 (1 phone), SO-41 (1 phone), SO-50 (1 phone), AO-51 (1 phone regardless of mode; PBBS-see Pacsats below), ISS (1 phone and 1 digital), PCSat (I, II, etc.) (1 digital), etc.

The ARRL has recognized the above rule and adopted it this year. From the ARRL rules:

7.3.7.1 Stations are limited to one (1) completed QSO on any single channel FM satellite.

- The use of more than one transmitter at the same time on a single satellite transponder is prohibited.

2. Digital Transponders

For the Pacsats (GO-32, AO-51) or 'Store and Forward' hamsats, each satellite is considered a separate band. Do not post "CQ" messages. Simply upload ONE greeting message to each satellite and download as many greeting messages as possible from each satellite. The subject of the uploaded file should be posted as Field Day Greetings, addressed to ALL. The purpose of this portion of the competition is to demonstrate digital satellite communications to other Field Day participants and observers. Do not reply to the Field Day Greetings addressed to ALL.

The following uploads and downloads count as three-point digital contacts.

- (a) Upload of a satellite Field Day Greetings file (one per satellite).
- (b) Download of Satellite Field Day

Greetings files posted by other stations. Downloads of non-Field Day files or messages not addressed to ALL are not to be counted for the event. Save DIR listings and message files for later "proof of contact."

Please note AMSAT uploaded messages do not count for QSO points under the ARRL rules.

Satellite digipeat QSO's and APRS short-message contacts are worth three points each, but must be complete verified two-way exchanges. Remember, only one digipeat contact is allowed for the ISS and other satellites in this mode.

The use of terrestrial gateway stations or Internet gateways (i.e. Echolink, etc.) to uplink/downlink is not allowed.

Sample Satellite Field Day Greetings File:

"Greetings from W5MSQ Field Day Satellite station near Katy, Texas, with 20 participants, operating class 2A, in the AMSAT-Houston group with the Houston Amateur Television Society and the Houston QRP club. All the best and 73!"

Note that the message stated the call, name of the group, operating class, where they were located (the grid square would be helpful) and how many operators were in attendance.

3. Operating Class

Stations operating portable and using emergency power (as per ARRL Field Day rules) are in a separate operating class from those at home connected to commercial power. On the report form simply check off emergency or commercial for the power source and be sure to specify your ARRL operating class (2A, 1C, etc.).

And Finally ...

The Satellite Summary Sheet should be used for submission of the AMSAT Field Day competition and be received by KK5DO (email or postal mail) by 11:59 P.M. CDT, Monday, July 16, 2007. The preferred method for submitting your log is via e-mail to kk5do@amsat.org or kk5do@arrl.net. You may also use the postal service but give plenty of time for your results to arrive



by the submission date. Add photographs or other interesting information so that can be used an article for the *Journal*.

You will receive an e-mail back (within one or two days) from me when I receive your e-mail submission. If you do not receive a confirmation message, then I have not received your submission. Try sending it again or send it to my other e-mail address.

If mailing your submission, the address is:

Bruce Paige, KK5DO
Director of Awards and Contests
P.O. Box 310
Alief, TX 77411-0310

A certificate will be awarded to the first-place emergency power/portable station at the AMSAT General Meeting and Space Symposium in October 2007. Certificates will also be awarded to the second and third place portable/emergency operation in addition to the first-place home station running on emergency power. Stations submitting high, award-winning scores will be requested to send in dupe sheets for analog contacts and message listings for digital downloads.

You may have multiple rig difficulties, antenna failures, computer glitches, generator disasters, tropical storms and there may even be satellite problems, but the goal is to test your ability to operate in an emergency situation. Try different gear. Demonstrate satellite operations to hams that don't even know the hamsats exist. Test your equipment. Avoid making more than ONE contact via the FM-only voice hamsats or the ISS, and enjoy the event! 🌐

AMSAT Satellite Summary Sheet - Field Day 2007

Satellite and number of Voice QSO's

AO-27 1 (example)

Satellite and number of CW/RTTY/PSK31 etc QSO's

FO-29 5 (example)

Satellite and Up/Downloads

UO11 3 (example)

Score Calculation

Total Voice QSO's	x 1 =
Total CW/RTTY/PSK31 QSO's	x 3 =
Total Up/Downloads	x 3 =
Grand Total	=

Please provide the following information:

Your Field Day Callsign

Your Group Name

ARRL Field Day Classification

ARRL Section

Power Source (Select 1)

Emergency

Commercial

Your name and home call

Home address

Any Comments



Straight Key Night Results

Many thanks to all who participated in AMSAT's 2007 Straight Key Night on OSCAR, held in memory of Cliff Buttschardt, K7RR. The following each received at least one Best Fist nomination from someone they worked:

Lee Herterich, K1VZI

Keith O'Brien, N4ZQ

John Lee, K6YK

Mike Herr, WA6ARA

Al Ozias, N7EQF

Mike Fullmer, KZ7O

Mark Spencer, WA8SME

Frank Wiesenmeyer, K9CIS

Ron McCulley, K0RJS

Congratulations!

73,

Ray Soifer, W2RS

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AMSAT Eagle Update

James A. Sanford, PE, WB4GCS, wb4gcs@amsat.org

Eagle Project Manager

Our Vision is to deploy high earth orbit satellite systems that offer daily coverage by 2009 and continuous coverage by 2012...



The Eagle team is starting to prepare for Dayton. I intend that we show you a UHF receiver prototype and test results at the booth this year. Hopefully we'll have it working and tied to a Software Defined Transponder (SDX). In the last few days we've had some brutal discussions regarding the use of plastic versus military parts. AMSAT has good experience with carefully treated plastic parts, but from the standpoint of making sure that Eagle *just works*, we're looking at military parts in some locations. This is a non-trivial discussion because AMSAT has good experience with carefully used plastic parts. Some of our constructors are relying heavily on their industrial experience and make a good case for the military parts – which some people consider LESS reliable, since they've been abused in testing before shipment. This is a good discussion, which I find enjoyable and intellectually stimulating. Carl von Clausewitz called it "healthy friction". We're also looking into lifetime buys of some parts based on today's ever-shorter product lifetime cycles. At the appropriate time decisions will be made and we'll proceed.

A Bill of Materials for the UHF receiver has been developed and parts are being ordered to build the prototypes. I have authorized construction of four prototypes – two to go through the Acceptance Test Plan (ATP) at separate locations, one to be evaluated by the SDX team and the last to be used for demonstrations, such as at Dayton.

The peer review is complete, and I have approved the ATP for the UHF receiver. Juan Rivera, WA6HTP, has done some very good work with this test plan. One peer reviewer called it, "Really good work. Can I expect to see this for all Eagle products?" I intend to use Juan's test plan and documentation as a model. Juan's plan is available for your perusal on EaglePedia at a revised UHF receiver page. Juan's team has access to a vacuum chamber, so after we've validated the receiver design with the ATP, we'll do it again in a vacuum and characterize the thermal issues as well.

Bob McGwier, N4HY, Tom Clark, K3IO, and Rick Hambly, W2GPS, have demonstrated in the last few days a software defined

transponder that will be used in SuitSat2. While the hardware is different, the software tests are contributing directly to what Eagle will fly.

Alan Bloom's sensor team has developed block diagrams and detailed schematics for sun sensor processing. Their work is capitalizing on previous experience and experiments. A PC board layout for the Sensor Electronics Unit is partially complete and detailed discussions are being held regarding sensor timing and CAN bus timing.

Ken Ernandes, N2WWD, is working with Lou McFadin, W5DID, and Bob Davis on modeling on-orbit power generation and the required power budget. Ken is using the Braxton Technologies, Inc. (BTI) Advanced Control Equipment Simulator Engine (AceSIM). This powerful tool is used by operators of the GPS constellation, among others, and provides a physics-based simulation that allows for a wide range of mission analysis. It will be used in refinement of the Eagle structure design, solar panel geometry and assessment of operations during Earth and Moon eclipses. The result will be optimization of the electrical power system, understanding of results of attitude control system actions and refinement of the sensor package. Braxton donated two licenses of this powerful tool to AMSAT; Ken is their Chief Astrodynamics Analyst.

Bob Davis is developing a half-size Eagle Structural model for Dayton. Stop by the AMSAT booth and take a look. As I stated earlier, I also hope to show you the UHF receiver and the ATP test results. If all goes perfectly well, we'll show you the receiver driving a software-defined transponder.

Gould Smith, WA4SXM, and I spent this past weekend developing a Work Breakdown Structure (WBS). This is a detailed decomposition of all work into discrete tasks that can be accomplished in a finite time. We developed the fundamentals for various types of subsystems and will now rapidly fill in task details for similar development and construction efforts. We had many discussions at the white board and this effort brought great clarity to work

that remains for Eagle. It is also clear where resources are lacking and overloaded – look for some targeted recruiting efforts in the near future. When the WBS is complete, Gould and I will verify that it says exactly what we intend it to say, and then ask the Eagle team to fill in details of resources applied and needed, task durations, and so forth.

The WBS will be used to develop a detailed project plan and schedule. To this point I've deliberately avoided any discussion of schedule. The project management "triple constraint" is "cost, schedule, quality – pick any two." I've deliberately focused on quality and cost. We are now at the point where we can see where the concept definition and refinement lead us in terms of schedule. We are seeking a realistically achievable schedule that does not force the integrators to jump through hoops for an arbitrary launch date – and leave out critical tests in the process. When we finish this plan, I intend to show the WBS and project schedule at Dayton. Stop by and let's talk about it. (It will also be on EaglePedia.)

As always, questions and comments to, wb4gcs@amsat.org

73,

Jim ☺



Field Ops Update - February 2007

by Gould Smith, WA4SXM, Director Field Operations, wa4sxm@amsat.org

First I would like to thank all the Field Ops team for the time, effort and resources that you donated to AMSAT over the last year. The many people that you have helped and educated certainly appreciate it also. The AMSAT Field Operations Team acts as Area Coordinators to:

- Represent AMSAT at hamfests
- Encourage satellite activities by doing demonstrations
- Serve as satellite 'Elmers'
- Make presentations at club meetings and hamfests
- Conduct local and regional nets
- Answer satellite questions via e-mail or telephone
- Provide articles for The AMSAT Journal
- Provide technical review for articles and the Web site
- Involve schools with satellite projects and demonstrations

We have added some new Area Coordinators in the last few months. Welcome to:

Patrick Stoddard, WD9EWK, Phoenix, AZ; A.J. Farmer, AJ3U, Hollywood, MD; Mike Scott, VE3FAR, Cambridge, ON Canada; Allen Mathis, N5AFV, Houston, TX; and Bob Hansen, K8RWD, Cadillac, MI.

If you are interested in giving back to AMSAT and helping to educate and Elmer potential amateur satellite operators, then send me an email at wa4sxm@amsat.org.

I will send you additional information about the Area Coordinator position. I am always looking for good people to represent AMSAT locally. AMSAT was represented at 49 hamfests in 2006. We are working on a presence at more hamfests in 2007.

Dayton 2006

We had a great show at the 2006 Dayton Hamvention. An avid setup team was there on Thursday to move the booth from the storage locker and setup in the Arena. We occupied the entire row last year, adding an additional booth to house the Eagle exhibits. There was a very good turn out for the Thursday Pizza Party, with lots of good talk and camaraderie. We had two forums on Saturday, the regular AMSAT forum and an AMSAT Educator's Forum. The AMSAT forum had presentations on P3E, Eagle, ARISS and AO-51. The new Eagle's nest area in the booth turned out to be a popular place. Tom, K3IO, Bob, N4HY, and Jim, WB4GCS, spent a good deal of the Hamvention demonstrating the operational SDX hardware. There were additional pieces of Eagle hardware on display as well. Memberships, books and trinkets were popular. We had a gross donation income of \$28,000 at Dayton, showing a steady increase over the last few years. Drew, KO4MA, our new VP of Operations, did multiple satellite demonstrations right outside the arena Friday, Saturday and Sunday. The Friday night AMSAT banquet

was held at the Amber Rose Restaurant where Lou McFadin, W5DID, gave an informative talk about SuitSat 1 and the upcoming SuitSat 2. There was more activity on Sunday than usual and a good group of volunteers helped take down the booth and move it back to the storage locker.

Thanks to all the 2006 Dayton booth volunteers - I am looking for your help again in 2007:

Don Agro, VE3VRW; Barry Baines, WD4ASW; Steve Belter, N9IP; Alan Biddle, WA4SGA; Bob Carpenter, W3OTC; Tom Clark, K3IO; Emily Clarke, N1DID; Drew Glasbrenner, KO4MA; Art Goldman, N3OY; Robin Haighton, VE3FRH; Rick Hambly, W2GPS; Dee Interdonato, NB2F; Jim Keeth, AF9A; Ed Krome, K9EK; Roger Ley, WA9PZL; Jerry Malin, N2HV; Bob McGwier, N4HY; Steve Meuse, N1JFU; Gunther Miesse, W8GSM; Wilse Morgan, WX7P; Tom Morrison, AB2PP; Chuck Pinkham, K3PER; Mal Preston, NP2L; Joe Prokop, KC8RAN; Keith Pugh, W5IU; Harold Reasoner, K5SXX; Jim Sanford, WB4GCS; Dieter Schielman, KX4Y; John Shew, N4QQ; Ken Shutt, K5GUU; Gould Smith, WA4SXM; Mike Young; WB8CXO.

Special thanks goes to Martha Saragovitz, Ed Collins, N8NUY and Nancy Makly, KC8GYW for all their help in making the Dayton experience such a good one.

The 2007 Goals for Field Ops are:

- Increase hamfest presence
- Improve the use of the FOSS (Field Ops Support System)
- Enlist the Field Ops team for Eagle fund raising
- Increase presentations/demonstrations
- Improve the hamfest revenues
- Increase the activity of inactive ACs and recruit new, active ACs

I have encouraged the Field Ops team to be proactive and contact local clubs and volunteer to present an amateur satellite program and/or demonstration. I have also asked each member of the team to represent AMSAT at least one hamfest and/or present a talk each year. It is very important to have a presence at these hamfests and to be known as a local satellite resource. You will find this quite rewarding, as well as educating potential AMSAT members and satellite operators.

The AMSAT booth is a busy place during the Hamvention!





Even spacemen stop by the booth.

FOSS is a standalone system that I use to manage and share information with the Field Ops team. It is not tied to any central AMSAT database. If you are an Area Coordinator and change your ISP, telephone number, callsign or address you need to log into FOSS and update your information. Please keep this information current. This is how people contact their local Area Coordinators and the e-mail addresses must be kept current. If any ACs have forgotten or misplaced their password simply send me an e-mail at wa4sxm@amsat.org and we will get you operational in short order.

The AMSAT Web site has an Events Calendar. I have asked all the Area Coordinators to post their AMSAT related events, hamfests, talks or demonstrations to the Events calendar. This is an excellent way to keep abreast of AMSAT activities in your area. It can be found on the AMSAT Web site using the left hand navigation or directly at <http://www.amsat.org/amsat-new/fieldops/events.php>.

There are many ARISS events scheduled this year. They provide an excellent opportunity to present the program to schools. If the contact takes place over the US, you can listen to the downlink (only) via an ARROW antenna and a 2M FM radio. The contacts are also provided on EchoLink and IRLP, so a school can listen to both sides of the entire QSO in real time. Using a tracking program projected on a screen showing the location of the ISS is also effective. Dieter, KX4Y, and Tony, VK5ZAI, post the upcoming contacts on the AMSAT Events calendar.

We have a great deal in common with the various VHF/UHF Societies. You will

enjoy attending one or more of their conferences. You will learn a good deal and meet some very kindred spirits. Upcoming VHF/UHF events are:

Eastern VHF/UHF Conference; <http://www.newsvhf.com/vhconf.html>; April 20-22, 2007; Enfield, CT

Southeast VHF Society <http://www.svhfs.org/>;

April 27-28, 2007; Atlanta, GA

Central States VHF Society; <http://www.csvhfs.org/>; July 26-29, 2007; San Antonio, TX

Pacific Northwest VHF Society; <http://www.pnwvhfs.org/>; Fall 2007; Location TBD

Digital Communications Conference; <http://tapr.org/dcc.html>; Sep 28-30, 2007; Hartford, CT

Microwave Update; <http://www.microwaveupdate.org/>; Oct 18-20, 2007; Philadelphia, PA

2006 AMSAT Field Operations Recognitions

Drew Glasbrenner, KO4MA

Drew continues to be a key contributor the AMSAT Field Operations team and an untiring volunteer. He has represented AMSAT at six central Florida hamfests, setup and tear down at Dayton, led the satellite demonstrations at Dayton as well as helped in the booth. In addition he has taken on the responsibility of leading the AO-51 Operations Group in determining the monthly operating schedule for that satellite. During the last year Drew had an integral part in setting up the Central Florida AMSAT Net. With repeater linking and Echolink connections this net now has worldwide check-ins. We are truly fortunate to have such a great volunteer and certainly appreciate all your efforts.

Keith Pugh, W5IU

Keith has consistently been a major contributor to the AMSAT Field Operations Team for many years. Since retiring his involvement as an AMSAT volunteer

has increased. In the last year Keith has represented AMSAT at seven hamfests, given forums and satellite demonstrations. At the Dayton Hamvention, Keith was there for setup, teardown, satellite demonstrations, booth duty and as a forum contributor. He assisted with the planning for the Louisiana Symposium and attended AMSAT BOD meeting and the Eagle meeting. He successfully mentored three ARISS school contacts during the last year. Keith also does the Amateur Satellite column for CQ VHF magazine. There were so many club presentations in central Texas, that Keith couldn't remember all of them. In addition he participated in Field Day making satellite contacts and found time to be a NCS for the 20 Meter AMSAT Net. Thank you Keith, for being such a devoted volunteer and role model for the AMSAT Field Ops Team.

Robert Davies, KI4HXT

Robert has quickly become a very active and important part of the AMSAT Field Ops Team. He has been a part of the AMSAT booth team at more than six hamfests this last year. Robert has done many satellite demonstrations to interest people in joining the amateur satellite community. Robert was one of the founders of the Central Florida AMSAT Net that is becoming one of the premier AMSAT nets. Thank you Robert.

Dee Interdonato, NB2F

Dee is a long time volunteer for AMSAT whose volunteer efforts never seem to wane. Last year he represented AMSAT at eight hamfests and events, as well as performing satellite demonstrations and making presentations. His involvement does diminish during the week as he is also part of the team that answers questions submitted via the Web site. Serving as one of the weekly ANS editors, Dee helps keep the membership up to date on AMSAT activities. Thank you Dee for your continued support of the Field Ops team and AMSAT.

Emily Clarke, N1DID

Emily has once again done a Herculean effort for AMSAT Field Ops. She has managed an AMSAT booth at many hamfest during the year and often given forums and demonstrations at the same hamfest. She was a valuable contributor at Dayton this year, being there for setup and booth duty every day. Her FOSS system continues to be a great communication tool for the Field Ops Team. Thank you for all your efforts.

Ernie Bauer, N1AEW

Ernie made three presentations on behalf

of AMSAT and added greatly to the Field Ops "Introduction to Amateur Satellites" PowerPoint this year. For the New England ARRL Convention he assembled a crack team of volunteers that presented interesting forums, gave satellite demonstrations and talked with many prospective AMSAT members. Thank you for your volunteer spirit and contributions to AMSAT.

Karl Sandstrom, K5MAN

Karl has been a great asset to the AMSAT Field Ops Team this year in answering many questions submitted to the Web site about satellite operations. He has 'Elmered' four people during the year and held six satellite demonstrations. During Field Day Karl operated the satellite station. Thank you for your contributions to AMSAT this year.

Dayton 2007

Dayton 2007 is just around the corner, May 18-20, 2007. I am looking forward to seeing many of you again at the AMSAT booth and hope you will spend a few hours helping at the booth. We will have many new and operational Eagle hardware items for you to look at and to operate. The Thursday night pizza party will be held at the same location, Marion's Piazza. An exciting change will take place on Friday night, the AMSAT banquet this year will be a joint AMSAT/TAPR Banquet held at the Air Force Museum. We will eat among the aircraft and have time to look at the Museum after dinner. Further details and online signup for the banquet are available on the AMSAT Web site and ANS bulletins.

The latest Area Coordinator list is published in this issue of *The AMSAT Journal*. 🌐

AMSAT Forum at Dayton

The AMSAT forum at Dayton this year has quite an impressive lineup of speakers and topics. The day and time of the forum has changed from past years. The forum will be on Friday afternoon, May 18, 2007 from 11:15am to 2:00pm.

Speakers and topics for the Friday afternoon AMSAT Forum are:

Moderator: Barry Baines, WD4ASW, AMSAT-NA Corporate Secretary

Rick Hambly, W2GPS, President, AMSAT-NA "Summary of AMSAT-NA Activities in 2007"



The outdoor satellite demonstrations are always well attended.



Jim Sanford, WB4GCS, AMSAT Eagle Project Manager (r), talks with a booth visitor about AMSAT's software defined transponder.

Peter Guelzow, DB2OS, AMSAT-DL President and Bob McGwier, N4HY, AMSAT-NA VP - Engineering, "Phase 3-Express: An Update"

Jim Sanford, WB4GCS, EAGLE Project Manager "Eagle Status Update"

Andrew Glasbrenner, KO4MA, AMSAT-NA VP-Operations and Gould Smith, WA4SXM, AO-51 Command Station, "AMSAT-NA

Satellite Operations and AO-51 Update"

Frank Bauer, KA3HDO, AMSAT-NA Director-Human Space Flight, "ARISS and Future SuitSat Missions"

Be sure to attend the forum to find out the latest information about current AMSAT projects. 🌐



AMSAT Area Coordinators Listing

State	Callsign	Name	Address	City	Zip	Phone	e-mail
Alabama	ke4azn	Mike Kingery		Enterprise			ke4azn@amsat.org
Alabama	n8deu	Tim Cunningham	109 Woodrow Balch Drive	Huntsville	35806	(256) 603-9351	n8deu@amsat.org
Alabama	kx4y	Dieter Schliemann	1803 Roseberry Drive	Scottsboro	35769-3960	(256) 259-3900	kx4y@amsat.org
Alaska	n1tx	Larry Ledlow	P.O. Box 10654	Fairbanks	99710-0654	(907) 488-8399	n1tx@amsat.org
Alaska	kl7uw	Ed Cole	P.O. Box 8672	Nikiski	99635	(907) 776-5829	kl7uw@acsalaska.-net
Alaska	kl7xj	Dale Hersherberger	Box 616	Sterling	99669	907 262 7988	kl7xj@amsat.org
Alaska	wl7bqm	Mike West	P.O. Box 452	Sterling	99672	(907) 262-5930	wl7bqm@amsat.org
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Arizona	wd9ewk	Patrick Stoddard	4031 E. Aster Drive	Phoenix	85032	(602) 787-0908	wd9ewk@amsat.org
Arizona	w7lb	Larry Brown	2721 S. Black Moon Dr.	Tucson	85730	(520) 886-1957	w7lb@amsat.org
Arkansas	kc5mlc	Gary Hollowell	2011 Hwy 32 West	Ashdown	71822	(870) 542-7158	kc5mlc@amsat.org
British Columbia	ve7wfg	Bill Greene	2230 Hayden Drive	Armstrong	VOE-1B1	(250) 546-6533	ve7wfg@amsat.org
British Columbia	va7vw	Ron Seiler	4001 15th Crescent	Vernon		(250) 545-3124	va7vw@amsat.org
California	kc7hex	Walter R. Jones, Jr.	2550 Hilborn Rd. #207	Fairfield	94534		kc7hex@amsat.org
California	w6te	Dave Smith	8373 N. Paula Ave.	Fresno	93720	(559) 323-6095	w6te@amsat.org
California	k6ux	Steve Egert	507 W. Valley View Drive	Fullerton	92835	(714) 322-8932	k6ux@amsat.org
California	n6shi	Ronnie Ginkowski		Hollywood	90068	(310) 725-7217	n6shi@amsat.org
California	kd6nxl	Joseph R. Rowen	788 E. Edison Street	Manteca	95336	(209) 823-5425	kd6nxl@amsat.org
California	aa6pa	Bill Rausch	6249 Marguerite	Newark	94560	(510) 299-0147	aa6pa@amsat.org
California	n2wwd	Ken Ernandes	1618 East Gate Way #302	Pleasanton	94566	(925) 462-3673	n2wwd@amsat.org
California	wa6dnr	Alan Bowker	16 S. Grove Hill Avenue	San Anselmo	94960-2355	(415) 459-1853	wa6dnr@amsat.org
California	wb6llo	Dave Guimont	5030 July St.	San Diego	92110	(619) 275-1495	wb6llo@amsat.org
California	w6sdw	Stephen Wilmet	5641 Camber Court	San Diego	92117-4045	(858) 277-7966	w6sdw@amsat.org



State	Callsign	Name	Address	City	Zip	Phone	e-mail
California	ko6bt	Duane Naugle	4111 Nemaha Drive	San Diego	92117-4522	(858) 273-4088	ko6bt@amsat.org
California	n1did	Emily Clarke	38 Tollridge Ct.	San Mateo	94402	(650) 349-5283	n1did@amsat.org
California	k6qxb	Herb Sullivan	2158 Floral Way	Santa Rosa	95403	(707) 526-3307	k6qxb@amsat.org
California	kq6ea	Jim Jerzycke	1954 W. Carson Street, #1	Torrance	90501	(310) 782-7336	kq6ea@amsat.org
Colorado	n0ntx	Tom McDaniel	4255 Shining Way	Colorado Springs	80916	(719) 570-1465	n0ntx@amsat.org
Colorado	k9mwm	Bob Ludtke	406 Yale Circle	Glenwood Springs	81601	(970) 945-8722	k9mwm@amsat.org
Colorado	k9ykl	Jim Young	401 CR 413	Granby	80446-9021	(970) 887-1014	k9ykl@amsat.org
Colorado	n0vse	John B. Gubbins	1106 W. Arapahoe Road	Littleton	80120	(303) 730-3992	n0vse@amsat.org
Connecticut	w1sl	Sherwood C.	30 Old Village Road	Bloomfield	6002	(860) 242-0392	w1sl@amsat.org
Florida	ki4hxt	Robert Davies	2402 N.W. Pinewood Ave.	Arcadia	34266	863-494-1505	KI4HXT@amsat.org
Florida	kb4syv	Ed Boyett	813 32nd STW	Bradenton	34205	(941) 746-5681	kb4syv@amsat.org
Florida	ku4os	Lee McLamb	3593 Tarragon Street	Cocoa	32926	321 636-1535	ku4os@amsat.org
Florida	kg4lyb	Rick Davis	3671 SW 59 Terrace, #4	Davie	33314	(954) 583-2420	kg4lyb@amsat.org
Florida	wd4fab	Dick Jansson	1130 Wilowbrook Trail	Maitland	32751	(407) 644-4008	wd4fab@amsat.org
Florida	ko4ma	Andrew Glasbrenner	6052 Central Ave.	New Port Richey	34653	(727) 817-1091	ko4ma@amsat.org
Florida	aa4kn	David Jordan	825 Hickory Hill Court	Orlando	32828	(407)380-2408	aa4kn@amsat.org
Florida	w4oep	Steve Park	12122 99 Ave. N.	Seminole	33772	(727)) 391-7515	w4oep@amsat.org
Florida	aa4md	Jim Huhta	11711 Rolling Oaks Lane	Tampa	33624	(813) 265-0427	aa4md@amsat.org
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Georgia	aa4rc	Robin Cutshaw	773 Cumberland Rd.	Atlanta	30306	(404) 892-6789	aa4rc@amsat.org
Georgia	k4edu	Roy Robinson	3058 Angela St.	Augusta	30907	(706) 860-6971	k4edu@amsat.org
Georgia	w4epi	Stephen Diggs	4181 Wash Lee Ct. SW	Lilburn	30047-7440		w4epi@amsat.org
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Georgia	kf4jex	Charles (Chuck) Rushing	113 Turkey Trail	Statesboro	30458	(912) 852-5797	kf4jex@amsat.org
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AMSAT Comes Together at Orlando Hamcation

David Jordan, AA4KN, aa4kn@amsat.org

The Orlando Hamcation is always a crowd pleaser for all that attend and this year was no exception. It has become one of the largest hamfests in the southeast with around 9500 attending, not including vendors.

All aspects of ham radio were well represented, including the satellites.

Several of us met on Friday afternoon to set up the AMSAT booth. Drew Glasbrenner, KO4MA, Vice-President of Operations had made the long haul up from New Port Richey, FL. Mike Burke, N4HHA, joined him. Mike's repeater is the Orlando area host for the weekly Florida AMSAT Net. In a short time, we had things ready to go for opening on Saturday. This also gave us the rest of the afternoon to peruse the tailgate area for any rare finds before the big crowd hit the next morning.

At 9:00 AM Saturday, doors opened. The weather was great and so were the crowds. We had secured a new location for our booth this year that put us right along the main aisle near the entrance and in the middle of all the action. As usual, a lot of our local friends and regular visitors arrived early to say "hi" and to scope out those rare items that go fast at the tables. We, of course, had several newbies drop by with questions about getting started.

One of the people I had a chance to speak with was an EE degree student from the University of Central Florida. He and his team are involved in a program to develop a satellite at UCF and are seeking help from AMSAT. Since our discussion, Lee McLamb, Lou McFadden and myself have been helping them with the satellite and their ground station.

As the morning continued, more help arrived at the booth. Robert, KI4HXT, drove up from Arcadia, FL to lend a hand and along with Drew, helped out with demos. Robert

was handling the first FM sat demo of the day when he ran into problems with ATV interference from a station on site. It was quickly located and the ATV station agreed to stop operating during the rest of our demos. As the morning went on, we were joined by Bob McGwier, N4HY, our Vice-President of Engineering. Bob had much to share with us. He was soon joined by our previous VP of Engineering, Stan Wood, WA4NFY, and BOD member, Lou McFadden, W5DID, who had brought along a SuitSat antenna prototype for viewing.

As the day went on, we had the opportunity for a VO-52 demo. Drew and Jeff Griffin, KB2M, attracted a sizeable crowd of on-lookers while Drew manned the mic and Arrow antenna and Jeff controlled the FT-817. It proved to be a good pass with a lot of activity.

When I returned to our booth after the demo, I was surprised to see an old friend, BOD member and VP of Special Projects, Barry Baines, WD4ASW. Many years ago, Barry had mentored me at the AMSAT booths and recruited me as an Area Coordinator. After visiting with Barry, I met up with another good friend, Ed Long, WA4SWJ, our *AMSAT Journal* Editor-in-Chief who dropped by for a chat.

As 3:30 PM approached, a crowd began to gather in the Pavilion for the AMSAT Forum where the status of recent launches along with progress on Eagle was discussed. Thanks goes to Executive Vice-President Lee McLamb, KU4OS, for organizing this year's forum and to the other presenters and those who made the meeting a success.

As 6:00 PM approached, the crowds began to slow and it was time to call it a day and head for our annual "de-briefing" meeting at our favorite BBQ joint where we decide what worked, what didn't and how to do it better next year.

The consensus was that the day had been a real success and we are looking for next year to be even better. I want to thank all those who helped support us in the booth and the forum, for all your efforts and especially the Orlando Amateur Radio Club for allowing us to be a part of Hamcation 2007. 📶

TAPR Call for Papers

Technical papers are solicited for presentation at the 26th Annual ARRL and TAPR Digital Communications Conference to be held September 28-30, 2007 in Hartford, Connecticut. These papers will also be published in the Conference Proceedings (you do NOT need to attend the conference to have your paper included in the Proceedings). The submission deadline is July 31, 2007. Please send papers to:

Maty Weinberg
ARRL
225 Main St
Newington, CT 06111

or you can make your submission via e-mail to: maty@arrl.org. Papers will be published exactly as submitted and authors will retain all rights.

73,
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